John R. Bartlett

SECOND BIENNIAL REPORT

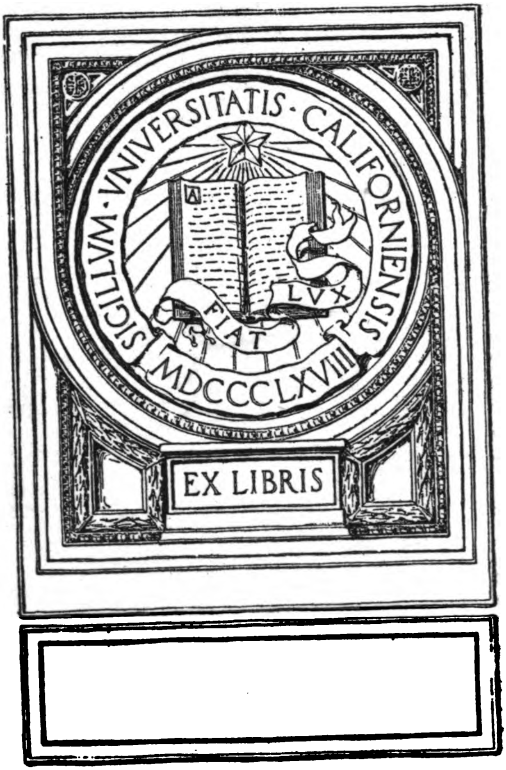
ON THE

GEOLOGY OF ALABAMA,

BY M. TUOMEY, A. M.,
Geologist to the State: Professor of Geology and Natural History in the University of Alabama.

EDITED, FROM THE AUTHOR'S M. S., AND OTHER PAPERS,
BY J. W. MALLET, PH. D.,
Professor of Chemistry in the University of Alabama.

MONTGOMERY:
N. B. CLOUD, STATE PRINTER.
1858.


SIGILLVM · VNIVERSITATIS · CALIFORNIENSIS
FIAT LVX
MDCCCLXVIII
EX LIBRIS

SECOND BIENNIAL REPORT

ON THE

)LOGY OF ALABAMA,

BY M. TUOMEY, A. M.,
t to the State; Professor of Geology and Natural History
in the University of Alabama.

EDITED, FROM THE AUTHOR'S M. S., AND OTHER PAPERS,
BY J. W. MALLET, PH. D.,
Professor of Chemistry in the University of Alabama.

MONTGOMERY:
N. B. CLOUD, STATE PRINTER.
1858.

Contents.

To His Excellency,

A. B. MOORE,

Governor of the State of Alabama.

Sir:

In fulfilment of the commission given me by His Excellency Governor Winston, and continued by yourself, I have the honor to lay before you the Report of the late Professor Tuomey upon the Geology of Alabama, arranged from the scattered manuscript, and illustrated by such additional matter found amongst the author's papers as seemed proper for publication with it.

I have the honor to be, sir,

Very respectfully,

Your obedient servant,

J. W. Mallet.

University of Alabama,

September, 1858.

To His Excellency,

JOHN A. WINSTON,

Governor of the State of Alabama.

Sir:

I herewith submit a second Report on the Geological exploration of the State of Alabama.

I have the honor to be,

With great respect,

Your obedient servant,

M. TUOMEY,

Geologist to the State.

University of Alabama,

November 25th, 1855.

Editor's Preface.

The long delay which has attended the publication of this, the second *biennial Report of the State Geologist of Alabama, and the surprise expressed in many quarters at this delay, render it proper that some explanation should be given, and this may be best done by stating briefly the facts with regard to the preparation and printing of the volume.

The Report was drawn up by Prof. TUOMEY in November, 1855, and presented to the State Legislature at its Session of 1855-6. On the 14th February, 1856, it was ordered that three thousand copies should be printed. A large portion of the M.S. was placed in the hands of Messrs. BATES & LUCAS—the printers at that time contracting for the work of the State—and one or two proof-sheets, as I am informed, were sent to Professor TUOMEY, and by him corrected. But soon the progress of the work appears to have stopped, and from time to time Professor TUOMEY was heard to complain of its neglect by the printers, until, at the end of March, 1857, his last short illness and unexpected death occurred.

On the 24th April immediately following, I was commissioned by His Excellency Governor WINSTON to supervise the passage of the Report through the press. I at once wrote to Messrs. BATES & LUCAS, and learned from them that they had 32 pp. of the work printed off (half of which had afterwards to be cancelled, owing to the extent of the errors found in it), 48 pp. in type but not corrected, and a quantity of M.S. not yet set up—the manuscript itself was said to be incomplete. I requested proof-sheets, and, after writing three times, at last, on the 13th June, received a single set, which were at once corrected and returned. No

*Before the institution of the Geological Survey of the State by the Legislature of 1853-4, explorations had been made by Professor TUOMEY at the cost of the University of Alabama; and the first Report, based upon these explorations, was published, at the expense of the State, upon the appointment of Prof. TUOMEY as State Geologist, then without salary, by the Legislature of 1849-50.

more could be obtained until, at the close of July, I called at the printing-office in Montgomery, and found that the work was at a stand—my corrections not made. I saw one of the proprietors of the office, heard many excuses for the delay up to that time, and gave specific instructions —which it was promised should be observed—with regard to the making of these corrections, printing off corrected portion, and setting up more of the work, during my absence for three months in Europe. On my return to Montgomery *nothing whatever* had been done; but it was stated that the delay was in part owing to the death of Mr. Bates, one of the partners of the firm. Having reported to Governor Winston the neglect with which the work was treated, I received from the printers some more proof in November and December (1857)—but, notwithstanding my repeated requests, no revises, or second proofs, were sent; the result of which neglect is to be noticed in the long list of Errata on p. 288.

The Legislature being now in session, the printing of this Report was discussed in both houses, and the matter was finally, by joint resolution, placed in the hands of his Excellency Governor Moore, to settle as he should deem advisable. Governor Moore did me the honor to desire (March 24th of this year) that I should continue to take charge of the work, and should supervise the completion of the printing at the office of Dr. Cloud—now State printer.

The M.S. being incomplete, I searched carefully for the missing part —with some success, recovering a portion in advance of that previously printed—,arranged the scattered leaves thus found, connected them where necessary by a few lines, and prepared such matter from Professor Tuomey's other papers as might suitably be appended in order to complete the work.

On the 10th April the M.S. of the Report, as now published, was placed in the hands of the printer. On the 18th June the first proofs were received; since then, with but one interruption, the work has been steadily advanced—its progress being necessarily somewhat delayed by correction of the press being carried on at a distance from the printing office.

It is but just to all parties concerned, and to the memory of Professor Tuomey, that the above statement should be made, shewing the neglect on the part of the former State printers which has been the main cause of the non-appearance, until now, of this Report.

If Professor Tuomey had lived to see the publication of his work, he would unquestionably have felt much pleasure in acknowledging the assistance of various kinds which was cheerfully extended to him during

the progress of the Survey in different parts of the State. Unfortunately no one can now supply the names of those to whom such acknowledgments should be made—the following memorandum, written several years ago, is the only one of the kind to be found amongst his papers.

"I have pleasure in acknowledging the assistance of several persons who interest themselves in the geology of the State. To Dr. SEWELL, of Athens, I am indebted for very efficient assistance in my explorations in North Alabama. I have received similar favors from Dr. ROBERTS, of Huntsville, and Mr. PYBAS, of Tuscumbia. To D. DESHLER, Esq., Civil Engineer, of the latter place, I owe the communication of an interesting section of the country between Mobile and the Tennessee river. For assistance in examining some of the newer formations near Mobile, I am indebted to Professor HALE, as I am also for an opportunity of using his fine collection of tertiary fossils. From J. P. WIER, Esq., of Eufaula, I received a collection of fossils from that locality. For the means of comparing our fossils with those of Mississippi, I have to thank L. RICHARDSON, Esq."

Many other gentlemen were obligingly active in assisting by all means in their power the investigations of the Survey in their respective districts of the State—and I much regret the impossibility of making in this place more than a general acknowledgment.

My own thanks are due to Mr. E. Q. THORNTON—assistant to the State Geologist during the Survey—for valuable information used in preparing parts of the M.S. for the press. J. W. MALLET.

An Act

To provide for a Geological and Agricultural Survey of the State.

SECTION 1. *Be it enacted by the Senate and House of Representatives of the State of Alabama, in General Assembly convened*, That the Governor is hereby authorized to appoint, as soon as possible, a State Geologist, who shall perform the duties herein prescribed, and during the period of his service shall hold no other office in this State.

SEC. 2. *Be it further enacted*, That said State Geologist shall as speedily as possible, make a complete and thorough geological survey of the State, so as to determine accurately, the quality and characteristics of its soil and their adaptation to agricultural purposes, its mineral resources, their location, and the best means for their developement, its water powers and capacities, and generally every thing relating to the geological and agricultural character of the State.

SEC. 3. *Be it further enacted*, That said State Geologist shall make a full report of his surveys and explorations into the mineral and other natural resources of the State, accompanied by illustrative maps, charts, and drawings, to the next session of the General Assembly, and the said report shall be the entire and exclusive property of the State.

SEC. 4. *Be it further enacted*, That said State Geologist for the performance of said services shall receive an annual salary of twenty-five hundred dollars, to be paid to him quarterly after his appointment, and the further sum of ten thousand dollars is set

apart and appropriated to aid the said State Geologist in the performance of his duties, by employing assistants and defraying the incidental expenses of his office, to be drawn for by him as needed, and his vouchers for all expenditures made from this fund shall be filed with the Comptroller, to be laid before the General Assembly.

SEC. 5. *And be it further enacted*, That in the event of a vacancy of the office of State Geologist occuring from any cause, before the completion of the survey, the Governor is authorized and required to appoint some suitable person to fill the place.

Approved, February 3, 1854.

INTRODUCTION.

PROGRESS OF THE SURVEY.

Soon after the passage of the above act, I had the honor to receive the commission of the Governor, and, after the necessary preparation, I took the field in the Spring of 1854 in company with Edward Q. Thornton, Esq., who was appointed assistant. About that time the public prints were filled with glowing accounts of mines of silver and copper, of unparalleled richness, discovered in various localities East of the Coosa.

Our first object* was to examine these remarkable mines, and we therefore passed as rapidly as possible to the Tallapoosa. The so-called silver mines, above Tallassee, did not detain us long and we proceeded to Chambers county, where we saw the

---

*Since the publication of Professor Tuomey's first Report—which was based upon explorations made at the cost of the University of Alabama—but before the passage of the above Act by the Legislature, some other parts of the State than those here mentioned were examined.

Much time was spent in "North Alabama, including the valley of the Tennesee and Russel's valley. A part of the coal region of DeKalb county, particularly that nearest to the Tennessee River, on Short creek, was also examined. That portion of Cherokee county between Greensport and the Blue Ponds was explored. Some time was also devoted to the newer deposits of the State, especially those of Mobile Bay."

Some of the results of this field-work are to be found in the present Report. [J. W. M.]

first shaft sunk in search of copper. From this place Mr. THORNTON proceeded to the Northern limits of the cretaceous rocks, and spent the remainder of the year in tracing out and settling the precise limits of this interesting formation.

I remained, East of the Coosa, the whole summer, in the discharge of the disagreeable duty of endeavoring to repress speculation, and to prevent, as far as possible, the consequences of the wild excitement which seemed to have seized the public mind. Of all the duties that fall to the lot of the Geologist this is certainly the least to be desired and that for which he receives the least credit. Very few men think it a favor to have their rich beds of copper transformed into mere iron ore, or their visions of immense wealth dispelled by a single blow of the hammer.

In the Fall I was joined by OSCAR M. LIEBER, ESQ., to whom was assigned the duty of the detailed exploration of the country East of the Coosa, especially with a view to the mineral deposits of the region. To this duty he returned again in the Spring of the present year, and has since continued his labors there.

On the first of January of the present year, Dr. MALLET was appointed to the chemical department of the survey ; he has consequently had but a single year to devote to his important work, and even this with great interruptions, owing to the difficulty of procuring the necessary materials, arising from the low state of the rivers. This department is, therefore, most behind. Enough, however, has been done to shew the great importance of the work.

The Railroad surveys which have, within the last year, been carried into the very heart of the mineral deposits of the State, seemed to indicate very clearly, that the awakened energies of the State would no longer suffer those deposits to remain neglected and unproductive. To go hand in hand with, if not to precede, this movement, seemed plainly the business of the survey, and with this view, W. ECHOLS HOLLOWELL, ESQ. was charged with the duty of re-examining, in detail, the various

ores of iron exposed along the great anticlinal valley of the State. In the discharge of this duty he continued, until the state of his health obliged him to resign his connection with the survey.

The survey has also derived much benefit from the occasional services of persons not permanently connected with it. GEORGE POWELL, ESQ., Surveyor of Blount county, has traced, with great labor, and corresponding accuracy, almost the entire boundary of the Warrior coal-field, and performed similar duties on the Eastern side of the Coosa coal-field.

SAMUEL S. GRAHAM, ESQ., of Coosa county, was employed for a short time, in tracing on the map the Western outline of the metamorphic rocks, in determining the position of the beautiful granite of Coosa, and in settling the limits of the drift on the Eastern side of the State, in the most satisfactory manner.

In 1838 LA TOURRETTE's Map of the State was published. The materials from which this map was compiled were the original land-surveys of the State, made by order of the General Government. These surveys being entirely linear, of course little attention was given to topography, beyond the noting of the points at which rivers and streams were crossed by the lines. The result is, that the map gives but a very incorrect view of the great physical features of the State. More than one considerably elevated range of hills is not only without location on the map, but without name. Many such ranges constitute natural boundaries between geological formations, and hence separate portions of the State that differ entirely in soil and productions, and should be represented on any map pretending to come up to the present state of knowledge amongst us. To accomplish all that was desirable here, would require the attachment, to the geological corps of a topographical engineer, but as this was not provided for in the appropriation, I was obliged to be contented with such corrections as we could make ourselves. In settling some interesting points of topography in Benton county, I was greatly aided by JOHN LINDSAY, ESQ., Surveyor of the county.

38

Early in the Spring of the present year, Mr. THORNTON and myself proceeded to the examination of that portion of the State drained by the Chattahoochee. On our way we re-examined the iron-ore and marble near Pratt's Ferry, and explored the country on Six Mile creek. We also made some interesting discoveries in passing hastily through the Cahawba coal-field. The limestone and slate of Shelby were examined, together with the interesting bed of iron-ore near Columbiana.

From Talladega Springs we followed the course of the valley in which the white marble of Talladega occurs. From this point we crossed the ridges of Coosa to Rockford, thence to Macon, passing over the edge of the cretaceous rocks to that very peculiar feature in this part of the State, Chunnennugga ridge. After examining this remarkable locality, our course lay along the Chattahoochee, as low down as Fort Gaines. From this point we turned Westward to examine the streams that drain the lower counties of the State. The greater portion of the Summer was spent in these labors, which are yet (November, 1855,) continued by Mr. THORNTON.

The results of these explorations will appear in the body of the report, with the exception of much that will only be proper for a final report on the entire geology of the State.

It will be seen by the date of the accompanying map* that it was constructed whilst the geological survey of the State was under the patronage of the University, and was intended to give a general view only, of the geological features of the State. It did not come from the printer in time to be distributed with the last Report, and has consequently remained on hand ever since.

*These observations refer to the map originally prepared to accompany the first Biennial Report, not to the map actually to be found at the end of the present volume. See Notice of map, p. 290. [J. W. M.]

Of course it does not embody the results obtained since its date, 1849, which are quite material, especially as regards the coal-fields, which have been so greatly extended, and the numerous mineral deposits, which were not then known.

M. TUOMEY.

GEOLOGY OF ALABAMA.

Chapter First.

Sketch of the Geology of North Alabama—Silurian and Devonian Rocks of Sheal Creek—Elk Creek and Limestone County—Carboniferous Rocks—Siliceous Beds—Muscle Shoals—Soils of the Cherty Rocks—Iron Ore of Bluff Creek—Carboniferous Limestone—Capshaw's Mount—Huntsville—Russell's Valley—Iron Ore of Russell's Valley—La Grange—Tuscumbia—Painted Rock—Coal on Short Creek—Mineral Springs of North Alabama—Bailey's—Stewart's—Todd's—Lee's—Witherspoon's—Moore's—Limestone Creek Springs—Franklin—Ligon's—Recapitulation of the Geology of North Alabama.

The silurian rocks that occupy so large a tract of country in Middle Tennessee, are exposed in North Alabama only where the superincumbent carboniferous rocks are removed, on the banks of the streams that flow into the Tennessee river; and are confined to their narrow vallies; and even here they rarely reach the river. Towards the South, they sink under the carboniferous rocks of the valley of the Tennessee. On the East, however, as was pointed out in a previous report, some of the long narrow folds of the Alleghanies extend into Alabama, and upon their sides may be traced the upturned edges of these rocks as far South as Centreville, on the Cahawba river. It was also shown, that the carboniferous limestones were but slightly affected by the force that elevated the silurian rocks of these vallies; so that the strata exposed in the spurs of the Cumberland Mountains that enter Alabama,

preserve their horizontal position, as they expand over that part of the State included between the Tennessee and its Northern boundary. They have, however, a Southern and slight dip, as is seen by the disappearance of the lower strata towards the South. It is only as I have just stated, where these rocks are removed towards the Northern boundary of the State, that the underlying silurian rocks are brought to view.

On Shoal Creek, one of the many beautiful streams of North Alabama, that have cut their channels through the carboniferous rocks in their course to the Tennessee Valley, the silurian rocks are found upon the right and left banks, a few miles from the point where this stream enters Alabama from Tennessee. The left bank is covered with a rich alluvial soil, but the encroachments of the stream have exposed a bed of mottled limestone very uneven on the surface, the result of unequal weathering. The colors are red and grey; the red portions being formed of argillaceous matter, colored by oxide of iron. This rock is a coarse variegated marble, and is exposed at this locality at low water. On the opposite side of the Creek, and lower down, a fine vertical section occurs, of a group of rocks that is quite conspicuous on the Cahawba, and along the valley of the Coosa from Blue Ponds to Ashville, and is seen again in Jones' Valley. The section is made up of grey compact and variously colored limestones, and on the top a thick bed of red argillaceous limestone, very much intersected by joints. Where this stratum is washed by the stream, sections of orthoceratites are not uncommon, and contrast curiously with the reddish brown color of the rocks. This section may be traced for a mile, and as the rocks are slightly undulating the beds are seen gradually rising, one after the other, above the water, and then sinking in the same manner. The strata composing this section are on the whole thin, the thickest rarely exceeding four feet. The prevailing colors are brown, red and grey, and as some of the beds are

compact and susceptible of a polish, a coarse variegated marble may be procured here. The bluff is thirty or forty feet high, and rises perpendicularly above the clear stream; its bright colors, contrasting with the deep green of the surrounding forest, present a view not a little picturesque.

A whitish or drab colored limestone sometimes appears above the water. This is magnesian limestone, easily recognised by its smoothly weathered surface.

A little lower down stream, this sinks below the surface, and the next bluff consists of heavy ledges of encrinital limestone fifty or sixty feet thick.

On the left bank, and farther down, these rocks are finely developed in a section one hundred feet thick. A few hundred yards from the Creek, a stream cuts through the bluff, and a spring branch, which rises in the encrinital limestone, flows down the outcropping edges of the rocks, laying them completely bare, and presenting a fine opportunity of studying this section. The whole rests upon a stratum of limestone which forms the bottom of the Creek.

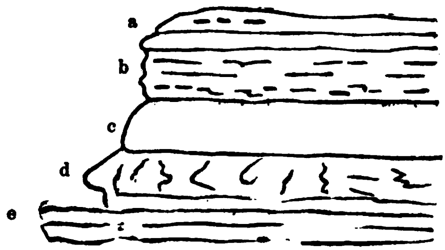
The gentle undulations of these rocks now become quite evident, and the black slate here rising above the Creek several yards, sinks till it occupies the bed of the stream at the mouth of the Cowpen's Creek. The ford at this point is completely flagged with this rock. It is harder and less slaty than usual, and it is divided on the surface by joints, into rhombic flags. A rapid current is produced here by the edges of the strata over which the stream passes; for these slaty rocks again rise above the bed of the Creek.

I have observed here, as I have elsewhere, that this rock resists decomposition, when covered with water, much better than could be expected from a rock so soft, and apparently so destructible.

One mile below the ford, another fine section of this group may be seen, in connection with the overlying carboniferous limestone.

SECTION BELOW THE MOUTH OF COWPEN'S CREEK.

(FIG. 1.)



a. A thin stratum of sandstone.

b. Black slate, about fifteen feet in thickness, passing down into a black sandstone which splits readily, and in some of its layers has the bedding planes studded with a small lingula in a beautiful state of preservation. This is the first locality at which I found any organic remains in the black slate, and even here they appear to be confined to the lower sandy portion of the stratum.

c. Magnesian limestone, 15 feet in thickness, breaking up with a smooth conchoidal fracture. It is white and even on the weathered surface.

d. Variegated limestone projecting in a heavy ledge, and presenting a rough water-worn surface. This bed is about 10 feet in thickness.

e. Grey magnesian limestone, rising above the surface at low water.

This black slate constitutes, in Alabama, I suppose, the upper member of the *Devonian* rocks.

These rocks are again exposed on Blue Water Creek, on Second Creek, on the Elk River, and on some of its tributaries north of Athens, near the Tennessee line, and extending down to Blair's ferry. On JONES' Spring Branch the slate is associated with a somewhat different group of rocks from those described. It has above a bed of cherty rock, and the variegated series of limestones is entirely wanting.

The following is the order of super-position of the rocks at this locality:

Clay.
Cherty rock.
Black slate.
Magnesian limestone.
Coarse grey, crystalline limestone.
Siliceous limestone.
Sandstone.
Blue fossiliferous limestone.

This last constitutes the bed of Maple Creek and its branches. It is rough, and very irregularly eroded, wherever it is laid bare and exposed to the weather. Near MOORE's Springs this rock contains cavities lined with snowy gypsum, and embedded nodules of this mineral. Above the mineral Spring the black slate is finely developed. There is a bed of magnesian limestone below it, but the colored limestones are absent in this section also. Where the slate becomes siliceous, towards the bottom, the little *lingula* already mentioned is quite abundant.

On another branch of the Creek, the blue limestone was traced up to the black slate and encrinital limestone. It seems that the blue limestone is the underlying rock of this entire region, that the variegated limestones of Shoal Creek, and of the Coosa and Cahawba vallies, are absent. The rocks have but a very slight dip, not exceeding 6° in any place; and hence the black slate is exposed on the sides of the vallies of these streams, whilst the blue limestone is exposed wherever the overlying strata are removed by denudation.

On the head waters of Limestone the slate is again seen near an old mill, above the mineral Spring, and at another point South of this, where it is finely developed, presenting on its surface irregular, embedded masses of chert. The

plantation of Col. N. DAVIS was the last place at which I saw this remarkable bed in that part of the State. I have already mentioned the existence of this rock on the Flint River, North of Huntsville.

CARBONIFEROUS ROCKS.

Although these rocks extend to the first falls on the Warrior and Cahawba, yet it is in North Alabama that the low members are extensively developed.

Taking into view mineral composition alone, they admit of division into two easily recognised groups: the upper calcareous rocks, known as carboniferous or mountain limestone, and the lower siliceous strata, called in Tennessee the siliceous formation. Beginning at the bottom of the series, we find reposing on the black slate some very well characterised beds, varying in thickness from 10 to 50 feet, very regularly stratified, and parting with ease along the bedding planes—a circumstance of some importance, as this rock is used, to some extent, as a building material.

In mineral composition it varies, being sometimes almost a pure limestone, very often quite cherty, and not unfrequently an ordinary coarse sandstone.

In the preceding report, I described a locality of this rock in the Valley of Blount Springs, where the beds are of the latter character, and another on the Cahawba, composed entirely of chert. On Maple Creek, a fine quarry has been opened in this rock, which is here highly calcareous, and made up, almost entirely, of fragments of stems of crinoidea. It is used for architectural purposes, and when dressed it has the appearance of a coarse white marble. The locks on the Muscle Shoals Canal are constructed of a similar rock, taken from a quarry a few miles distant. It works with ease, and judging from what I saw at this place, it is a pretty durable building stone.

The following analysis represents the composition of the less pure portions of this rock:

(Composition in 100 parts.)

Carbonate of lime,	54.25
Carbonate of magnesia,	.34
Alumina,	.24
Peroxide of iron,	1.21
Phosphoric acid,	trace.
Insoluble matter,	43.44
	99.48

The stratum on Maple Creek is about 12 feet thick. The weathered surface, covered with crinoidal stems left standing out in high relief by the wasting of the rest of the rock, presents a curious appearance. The great abundance of these remains has suggested for this rock the name of encrinital limestone, by which it was first denominated by the late Dr. TROOST, in his reports on the Geology of Tennesssee.

At all the localities of black slate on Shoal Creek, this rock is present, but generally in the form of an impure siliceous limestone, filled with crinoidal stems.

On the Cowpen's Creek, a little stream that empties into Clear Creek, a very interesting locality occurs between the Saw Mill and the Woollen Factory; here the rock is exposed along the mill-race; it is an impure limestone colored somewhat green. It is much disintegrated, and as the fossils are silicified, being converted into bluish hornstone, they remain scattered over the surface; among them are large fragments of elliptic shaped stems of *Platycrinus Saffordii*. The stems occurring at this place are much larger than any that have come to my notice. In an excavation at the Saw Mill, I found some bones of fossil fishes, and among them fragments of the offensive weapons called *Ichthyodorulites*, belonging to the genus *ctenacanthus*, allied to *c. tenuistriatus*, *Agass*, a species characteristic of the carboniferous limestone of England.

In an economical point of view this rock may prove interesting, on account of the phosphate of lime which it contains. The following is its composition:

(In 100 parts.)

Carbonate of lime,................................	16.41
Phosphate of lime,................................	14.19
Peroxide of iron,................................	.36
Quartz, and other insoluble matter,.........	68.72
	99.68

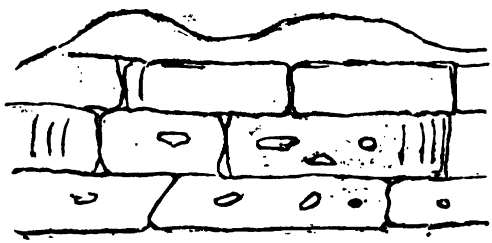
In my first report, I referred this rock to the carboniferous system, because I found the carboniferous limestones always resting conformably upon it, whilst both rest unconformably upon the underlying, highly inclined silurian or devonian rocks, wherever they are found along the great anticlinal vallies of Alabama.

I pointed out this want of conformity as the means of distinguishing the two systems in the absence of organic remains. In North Alabama, however, it is impossible to apply this test, for both the devonian and carboniferous rocks are alike slightly inclined.

Next in order above the encrinital limestone, a fine and very remarkable series of siliceous strata occurs, attaining the thickness of 200 feet where best developed. Like the encrinital limestone, this group is characterised by the regularity of its stratification; the natural sections often present the appearance of masonry, a resemblance that is rendered the more striking by the vertical joints by which the strata are intersected.

The following section (Fig. 2) represents the general appearance of the bluffs formed of this rock:

(FIG 2.)



This section is taken at a point on Cypress Creek, opposite the grist-mill.

But the mineral composition of this formation constitutes its most remarkable feature. In some places it is an impure limestone, passing into a coarse cherty rock, and at others it becomes hornstone, having the lustre and fracture of flint, with numerous embedded nodules of quartz, variously colored, and sometimes of considerable size. One, from the Muscle Shoals, measured a foot in diameter.

Pretty good specimens of jasper, carnelian, and chalcedony are found among these nodules, which explain the origin of the minerals found among the drift towards the South.

It is during the various stages of disintegration, to which this rock is subject, that the most puzzling appearances are assumed. From solid hard chert, it is seen passing into a substance scarcely distinguishable from clay slate, were it not for the absence of the smooth cleavage planes of the latter; instead of these, and when split in the direction of the bedding planes, the surfaces are rough and uneven, and the fragments are often flatly lenticular. Not unfrequently, the very densest portions of the rock pass into a chalky substance resembling tripoli. I have described elsewhere this change in the cherty seams that occur in limestone, but I have not before seen bluffs, some yards in thickness, composed of this altered chert, such as were pointed out to me by F. A. L. LANSFORD, Esq., near Gravelly Spring, P. O., Lauderdale county. It

requires that one should see these changes absolutely in progress, in order to believe that mineral substances, apparently so widely different, should have the same origin.

From Florence to State Line Ferry, the public road for a considerable distance winds along the foot of the mountains, as they approach the valley of the Tennessee river, and as these are composed for the most part of this rock, scattered angular fragments strew the surface, indeed the road itself is composed of these fragments, and hence its excellence. Beds of impure limestone are very often interstratified among the more siliceous beds, as may be seen at Bluff Spring P. O., on Bluff Creek. It is unnecessary to describe more than a few localities of the rocks of this group, as they are the prevailing rocks of both Lauderdale and Limestone counties. On Clear Creek many excellent localities occur. On Cowpen's Creek, near the Woollen Factory, the falls as well as the banks of that stream are composed of this rock. Below this and near Bailey's Springs, the vertical bluffs are made up of it. On Cypress Creek, numerous escarpments are found, presenting all the characteristics of the formation. At the Bran-dance Spring above the Cotton Factory, near Florence, a quarry has been opened for procuring building stone, where the rock becomes calcareous, and is intersected by vertical joints that often separate the solid from the decomposed portion of the rock. Opposite the Factory, fine sections are exposed; along the bedding planes of the strata the rock is somewhat disintegrated, and the beds are left standing out like courses of masonry. But it is at the Muscle Shoals, that the most striking sections occur. The bed of the river for the entire distance of fifteen miles, occupied by these noted shoals, is composed of this lowest siliceous formation. Between the ferry, at the lower extremity of the shoals, and the mouth of Shoal Creek, a vertical escarpment of about ninety feet occurs above the level of the canal, on the right bank of the river, which presents in the distance of two miles, the geological character

of the entire shoals. The fall of the shoals in fifteen miles is about eighty-five feet, and as the rocks along the bed of the river are nearly horizontal, it follows that the river must flow over the strata exposed in this bluff. At the head of the shoal, where I examined it again, I found the rocks of this section sinking below the surface, and the calcareous superincumbent rocks, making their appearance on the river bank. The rock along the shoals is of a dark color, and flinty structure and hardness. Besides producing the shoals by its indestructable character, it was curious to see how the very stratification of this rock was impressed upon them. The thickness of the strata composing the section here varies from one to three feet, and the shoals consist of a series of steps corresponding in height with these; the direction of the steps across the river is also that of the joints that intersect the strata. The most favorable "chutes" occur where the strata are thinnest, and where consequently the water falls least abruptly. The shoals consist of a series of cascades; scarcely a single fall exceeding three feet in height. The river is two or three miles wide at this point, with here and there a green islet fringed with drifted wood, and appearing as if the willows and other trees upon them grew from the water. Many a scene of quiet beauty, well worthy of the painter's pencil, is presented both here, and elsewhere, on this magnificent river.

It was painful to contemplate the abortive attempt at "internal improvement," presented by the dismantled locks of the canal around the Muscle Shoals. So completely has every vestige of wood and iron disappeared, that a stranger might very readily suppose that he had come upon an unfinished work. The masonry of the locks, composed of the white encrinital limestone, appears quite new and perfect, as if just from the hands of the contractor. Yet I believe that the canal was in operation for a brief season; that one of those breaches, incident to all new works of a similar character, occurred, which was never repaired—and so it stands.

Leaving the bed, exposed along the banks of the river, we ascend to the plateau upon which the carboniferous limestone rests. The beds exposed here are still siliceous, but much disintegrated. On the hills west of Clear Creek, after leaving the river, I soon recognized the white porous siliceous rocks that I had previously studied at the base of the mountains near Huntsville. They abound in corals of the genus *Gorgonia*, and are altogether more fossiliferous than the lower rocks of the formation.

The soil derived from their disintegration and decomposition is red, and mixed with angular masses of chert. When I first saw surface beds of this character as I approached Tuscumbia from La Grange, I was disposed to refer them to the drift, but as they contain no rounded and water worn pebbles, this opinion must be given up; and although they present marks of having been removed, yet I believe it was rarely from a distance, and in every case they had their origin in the upper beds of the siliceous strata, of the carboniferous rocks. On both sides of the valley of the Tennessee, at Florence, vast beds occur on the hill-sides composed of the ruins of these beds, and the one on the brow of the hill, at the latter place, presents unmistakable signs that it had been subjected to the transporting force of water, perhaps when the Tennessee commenced the excavation of its channel.

On the plantation of Col. N. Davis, I had an excellent opportunity of examining the soils derived from this rock; and although the disintegration had proceeded to a considerable depth, portions of the rock may be seen, quite solid, and retaining its original position; showing that the soil has resulted from disintegration on the spot. I stated that cherty limestone is often found interstratified with this rock, and hence the excellence of the best soils of the high lands of this entire region. When mixed with organic matter, like all limestone soils, they become more or less brown. The analysis of these soils will, I think, show the presence of a considerable proportion of lime.

IRON ORE.

Before describing the carboniferous limetones, it may be proper to allude to the beds of iron ore associated with the siliceous group. The first of these that I examined is found on the hills on the right bank of Shoal Creek, two or three miles above the mouth of Cowpen's Creek. The bed consists of irregular masses of conglomerate, composed of rounded pebbles and angular pieces of chert, cemented by oxide of iron. Wherever the iron predominated the ore was a good brown hematite; but as this was rarely the case, the labor of selecting the good from the worthless ore, would be too great to allow of any profitable use of the bed.

On Bluff Creek, I examined another bed a short distance above the Postoffice; although much richer than the preceding, it was nevertheless much contaminated by foreign substances, and much labor would be required in the selection of the workable portions. Some openings were made in the bed, which is of variable thickness; expanding into immense masses, and then thinning out, or disappearing altogether. Neither of these appear to be true beds, that is, beds enclosed in the rocks, but rather deposits resting upon them, and derived from the ruins of other beds.

Upon the tops of the highest hills in Lauderdale, I saw beds of ferruginous conglomerate and sandstone; the latter looking to an inexperienced eye somewhat like iron ore. These cannot be confounded with the beds just described; the embedded pebbles are all common quartz, completely rounded, and brought from a distance. These conglomerates are known in the county by the name of "cement rocks," and are thought to result from the action of fire. They are, however, formed in this simple manner: if we suppose a bed of pebbles covered with water, or even with soil, containing much iron; the iron being precipitated among the pebbles, as it solidified would consolidate the whole mass, and this opera-

tion any one may observe in progress, where a bed of pebbles rests upon a stratum of clay, and is overlaid by a soil containing iron. I observed that this "cement rock" in more instances than one, was a matter of interest with a certain class of our citizens that still continue to amuse themselves with looking for the precious metals by means of a "mineral rod." It seems now scarcely necessary, excepting for the information of such persons, to observe, that it is but an idle waste of time to look for any thing beyond iron ore in these beds. Towards the South these cherty and siliceous rocks sink beneath the carboniferous limestone that bounds the valley of the Tennessee, and towards the East, they are covered by the spurs of the Cumberland Mountains.

CARBONIFEROUS LIMESTONE.

The base of this formation is not everywhere equally well defined, for the reason that beds of chert and limestone often alternate.

On the Cowpen's Creek, immediately overlying the siliceous rocks, a cave occurs, in a coarsely crystalline limestone; the roof is siliceous and intersected by joints, which determine the direction of the chambers of the cave. The walls were wet at the time of my visit, from the percolation of water, but there were no stalactites, which is probably owing to the soft and disintegrated state of the walls as well as the absence of lime in the roof. On the floor I observed soft masses of a dark brown substance, which at first view, I referred to decomposing excrements of animals, but it wanted the odor of animal matter, and on farther examination I found it was one of the constituents of the rock, that was left after the lime was all disolved out; for I found it to be carbonaceous matter that entered into the composition of the rock. I apprehend that this is the origin of a great part of the dark colored deposits found in our caves, with other earthy substances, and not to be confounded with beds of animal origin.

Some very interesting "bone caves" are found in the vicinity of Tuscumbia, a knowledge of which I owe to Mr. Pybas, of that town. In one of these the remains of the mastodon* were found, and in another great quantities of bones first noticed by Dr. Powel; amongst them occur the remains of the *megalonyx*. Near Huntsville, another cave of considerable extent was pointed out to me by Dr. Robinson; large specimens of *spirifer striatus* are found here in considerable numbers. It is probable that these caves occur in the same thick bed of coarse limestone, near the base of the carboniferous limestone. Towards the East, the first well characterised strata of this formation are seen at Capshaw's Mountain, a little knob that rises abruptly from the great platform of siliceous and cherty rocks that we have been examining.

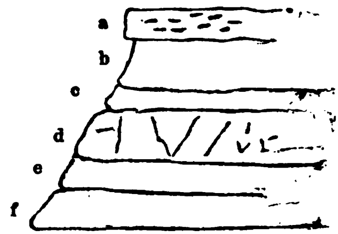
CAPSHAW'S MOUNT.

This knob is the counterpart of the mountains near Huntsville, with the exception of the absence of some of the Huntsville strata at Capshaw's. All that portion of Flat-top Mountain above the lower stratum of sandstone, is wanting here; nor did I observe the thick bed of limestone with oolitic structure at the base of Capshaw's.

The wood cut (Fig. 3) presents the order of superposition of the rocks at this little mountain:

* A fragment of a tusk was politely presented to me for the University Cabinet by A. C. Mathews, Esq., Editor of the Franklin Democrat.

(Fig 3.)



a. Sandstone, with impresions of coal plants. A thin soil is formed on this rock which supports oaks and other forest trees, and is the equivalent of sandstone upon which La Grange stands.

b. A thick bed of limestone.

c. A stratum of yellow limestone that takes a good polish, and would make a handsome marble. It is, however, not more than two feet in thickness.

d. Ordinary limestone, containing the fossil archimedes in abundance.

e. Magnesian limestone, with white smooth weathered surface, and four or five feet in thickness.

f. Cherty limestone.

In the vicinity there are some other little elevations, composed of the lower members of this mountain. As usual, cedars grow in thick profusion, up to the very verge of the sandstone, where they suddenly terminate, to give place to plants that love a thin siliceous soil.

HUNTSVILLE.

The beautiful town of Huntsville stands in a valley nearly surrounded by spurs of the Cumberland Mountains, that run down on the right and left to the river. The rock upon which the town stands, may be seen at the Spring,* near the water

* The great Spring at this place, besides supplying the town, vents a stream of water, at the rate of 825 cubic feet per minute.

works; it is a hard cherty rock, the siliceous seams standing out on the surface. Overlying this, and towards the base of Montesano, a very thick bed of limestone may be traced for a considerable distance around the mountain. It is for the most part a compact bluish colored rock; some parts, however, are white, and the small shelly and concretionary grains which give it an oolitic structure are quite perceptible. This portion of the rock is cut with ease; it has besides a showy appearance, and for these reasons principally it is used extensively for architectural purposes, but it is far from being the most durable rock that could be procured in the vicinity. The rest of the rocks composing the mountain are common limestones, a stratum of magnesian limestone; and the presence of the thin seam of yellow marble already referred to is indicated by scattered fragments on the surface. The lower sandstone is much better developed at the Southern extremity of the mountain than here, although at this place it is also present. The top of the mountain is capped with a thick stratum of coarse sandstone, belonging to that formation which lies at the base of the coal measures, called mill-stone grit; it is spread out completely over the mountain top, which is quite level and presents the aspect and assemblage of plants peculiar to the soils of the coal measures. If we suppose an equal area of Walker county to be elevated 800 feet above the level of the rest of the surface, it would present precisely a similar appearance. Yet these knobs, scattered over Madison county, are not the result of any such elevation; but of the depression of the rest of the surrounding country by denudation. In the last report I mentioned the remarkable series of terraces extending around the sides of these mountains. I find them everywhere present, and the result of the unequal wasting of the strata composing the mountains. Many of the limestones are highly argillaceous, and are subject to disintegration; and if an underlying bed be less destructible it remains to form a terrace whilst the upper one is washed away.

3

These terraces are frequently ten or twelve feet wide; and in length may be traced around the mountain.

The bed of sandstone above is in many places outcropping in vertical ledges, that expose at their base a thin seam of coal; where I saw it, there was much sulphuret of iron present, and at all events I think it doubtful, that a bed of coal only ten or twelve inches thick can, where other fuel is so abundant, be worked profitably. This is the seam that is exposed on Short Creek above Gunter's Landing—on the opposite side of the river, and again on the Eastern slope of Racoon Mountain; but it becomes much thicker in that direction.

The summit of Montesano, with its fine prospect, pure atmosphere, and coolest fountain of spring water in the State, offers a delightful place of summer resort to the inhabitants of Huntsville, although the road by which the ascent is made is not the smoothest possible even for a mountain road.

GEOLOGICAL STRUCTURE OF RUSSELL'S VALLEY.

After tracing a section from Tuskaloosa, over the coal measures and mill-stone grit of Fayette and Walker counties, the carboniferous rocks of this valley were examined. In the North-East portion of Hancock, the mill-stone grit rises into a ridge that bounds the Warrior basin on the North, in Lawrence and Morgan counties, and extends East to Brown's Valley. This ridge forms the water-shed between the streams that flow into the Tennessee, on the North, and the head waters of the Warrior on the South; and towards the West, along the Northern line of Walker, it separates the tributaries of the Tennessee from those of the Tombigby. Besides thus impressing itself on the physical features of the State, it forms an important geological boundary, marking as it does the northern limits of the productive coal measures of the Warrior coal-field.

In mineral composition this rock differs from the mill-stone

grit of the Eastern boundary of the coal-field principally in the thickness of the beds of conglomerate so conspicuous there. It passes from ordinary sandstone into the white arenaceous rock, to which I have frequently alluded in another place, as constituting an excellent fire-proof stone.

Descending the steep declivity of this ridge towards Russell's Valley, we soon reach the underlying limestone, which is disposed, like all the carboniferous rocks of North Alabama, in horizontal beds. It is compact, and frequently argillaceous, the exposed surface often rough with marks of imperfect bedding planes, but sometimes quite smooth. Pentremites are quite common, and the archimedes of Lescur is every where seen on the weathered surface of the rocks.

The soil and natural growth of the Valley were in striking contrast with those of the monotonous sandstone ridge passed over.

Descending toward Evett's, the lower cherty limestones are found. We heard reports of precious metals having been found here, which unfortunately turned out to be nothing better than sulphuret of iron, no uncommon mineral in limestone. Across from the main road to Newburg, the way is over flat, broken and otherwise uneven horizontal beds of limestone, perfectly bare; and although being as bad a road as need be desired, presented good opportunities for studying the prominent rock of the valley. All the characteristic fossils of the upper beds of this formation occur on the weathered surface of the rocks at Newburg. Dr. Smith, of this place pointed out many of these to me, and was kind enough to show me a bed of iron ore, the examination of which was the special object of my visit to Newburg. The ore is found insterpersed through a thick bed of red loam, over which the road passes, and which forms the soil of a strip of country extending across the valley. The first indications of the ore are seen near the Meeting House; it is a brown hematite in the form of nodules and irregular masses,

the fractured surfaces indicating that they were broken from larger masses. This, taken together with the pieces of chert, compact and vesicular, scattered through the bed, shows that it is not in place, but is the ruins of a bed of iron ore, that was broken up and re-deposited. Many of the fragments of chert are water-worn, showing that the whole was brought from a distance.

About three miles from Russellville, another bed occurs in a ridge running North 30° West. For some distance in this ridge, iron ore is found in greater or less abundance; it is in general of good quality, and free from intermixture with foreign substances. Numerous excavations in the ridge mark the spots from which ore was procured for the supply of a furnace that was once in operation on a branch of Bear Creek, about three miles beyond the village. The ore is of excellent quality. A considerable amount of labor was required for the extraction of the ore, for it is scattered through the bed of loam, and whilst the beds are rich in some places they may be barren at others; and as the surface rarely presents any indications of bodies of ore, much unproductive labor must have been the result.

On the way to the furnace, indications of the existence of ore are found on the surface, and an occasional excavation was seen; but the ore in the vicinity ot the furnace is much less pure than that of the beds between the village and Newburg.

The ruins of the furnace still remain, and the fragments of iron scattered about show that both castings and malleable iron were manufactured here. The high charges and difficulties of transportion are the causes to which the suspension of these works are attributed. Patches of drift are found scattered in detached beds over the surface of the valley, as well as on the hills. Specimens of the oolitic limstone may be seen in the streets at the village, but it is said not to be very durable, especially when exposed near the surface of the ground.

The limestones of the valley are exposed towards the North a little beyond the Franklin Springs. The valley is contracted to a narrow pass between two limestone hills, on the tops of which loose pieces of iron ore are found. Towards the North the limestone disappears beneath a thick stratum of sandstone, which is spread out towards the East and West. This stratum is best seen at Ligon's Springs; on one of the branches of Little Bear Creek, about two miles and a half North-West of the Franklin Springs. In the bed of the branch, the lower part of the rock is finely exposed; it is composed of loose siliceous grains, slightly cohering, forming a very porous sandstone, through which water percolates very freely. It is from this rock that the springs rise. If a hollow be excavated in the surface it soon becomes filled with water containing the same mineral ingredients as those of the principal spring, among which chloride of sodium is prominent. This rock, I think, would answer well for the construction of filtering vessels, for the purification of water for domestic purposes. Overlying this rock are beds of sandstone, that split up readily into slabs, that make excellent flagging stones. The total thickness of all the beds exposed here, is about 150 to 200 feet. Pursuing the branch upwards, we arrive at the upper surface of the formation and find a little knoll, twenty or thirty feet high, composed of limestones filled with pentremites, and on the weathered surface the archimedes is often found. This isolated little hill has very much the appearance of the mounds, of Indian origin, found in various parts of the State; and if the stratification of the beds did not remain undisturbed, one might easily confound the two. Other localities of the upper beds of carboniferous limestone are found resting upon the sandstone plane, South of the Springs. We have here then a very fine example of the stratum of sandstone enclosed in the carboniferous limestone—hich I have designated the lower sandstone of this formation. I have as yet seen but little in either Lawrence

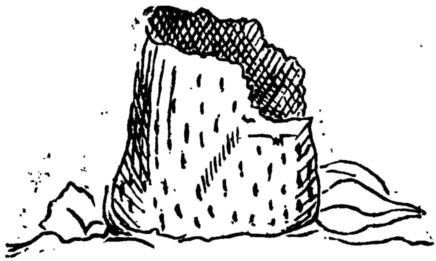
or Morgan counties, but I am inclined to think that this formation caps the hills forming the Southern boundary of the Valley of the Tennessee, in both these counties. Between Ligon's Springs and Lagrange, the sandstone is often denuded, and the limestone is found in the depressions scooped out by the streams—still sandstone is the prevailing rock.

LA GRANGE.

There is nothing peculiar in the approach to LaGrange, but once reached, the country seems suddenly to have sunk, and the traveller finds himself looking down into the Valley of the Tennessee, from an elevation of 300 or 400 feet. Around the village, whenever the sandstone plateau is removed, the limestone presents itself, and by its wasting has undermined the superincumbent rock which has fallen down, and lies scattered about in irregular masses below the outcropping edges of the sandstone. On the road down into the valley, immense fragments, like ruins, lie on each side of the way, and precipitated down the hill-sides, covering and protecting from further waste the edges of the underlying calcareous rocks. But the most interesting and remarkable feature of this locality, and the one for which LaGrange will always be distinuished, is the profusion of the remains of fossil plants. I have mentioned elsewhere that no coal has yet been found in Alabama in this lower sandstone—for such is the rock upon which LaGrange stands—yet nowhere can one gain such ideas of the magnificence of the flora of the coal period as at this place. Trunks of lepidodendra, two to three feet in diameter, lie buried and protrûding from the debris of the sandstone. These trunks, in general, have preserved their form, are not at all compressed, showing that they stood erect in the beds that enclosed them. Although entirely decorticated, the scars are impressed on their surface.

Fig. 4 represents one of these fine specimens, which stands on the road side and is used as a substitute for a horse block.

(FIG. 4.)



Fragment of Trunk of Lepidodendron from LaGrange.

This fine specimen is three feet in height; the circumference at top is seven feet seven inches, and at bottom eight feet six inches. The plants, however, are not confined to this genus; wherever the bedding planes of the sandstone are exposed, they are covered with impressions of calamities and stigmaria, the latter often of considerable size, showing in some specimens a distinct bifurcation.

In my first report I pointed out a locality in the mountains of Madison, where the upper surface of this sandstone is impressed with stigmaria as thickly as they are ever found on the floor of a seam of coal, and suggested the explanation, that the rest of the remains of these plants were destroyed by denuding forces, before the deposition of the superincumbent limestone. The same conditions must have existed at this place; but the remains left behind to attest them are far more abundant and in better preservation.

The descent from this most interesting locality is precipitous, over the edges of the limestone, which contains characteristic carboniferous fossils. The Valley of the Tennessee is here ten miles wide, slightly undulating, and elevated about fifty feet above the general level of the river. The underlying rocks are here and there exposed, and numerous depressions, called limesinks, mark the wasting influences going on below the surface. The rocks forming the bottom of the

Valley are covered for the most part with a subsoil derived from the cherty limestones of the siliceous beds. Angular and water-worn fragments are found embedded in the red loam upon which the soil rests. Towards Tuscumbia, the Valley contracts rapidly, and the town is approached over the ruins of the cherty strata, and on the road side, in the suburbes, thick beds of loam and siliceous fragments occur. These beds seem to be accumulations, which have not, however, been removed to any great distance, rather than the result of disintegration in place. The fragments from these beds are about the proper size for materials for a road covering, a purpose which they answer admirably, as may be seen in the streets of Tuscumbia.

The rain water that falls in this part of the Valley, and perhaps still farther to the South, finds a vent through a magnificent fountain at this place, which discharges, according to the guaging of D. Deshler, Esq., Civil Engineer, 17,724 cubic feet per minute, which he considers a pretty fair average for the whole year.

On the Tennessee, above the mouth of Paint-rock Creek, a fine section of the carboniferous limestone occurs at what is called the painted rock. This is a spur of one of the mountains of Jackson, that extends to the river and is cut in two exposing on the right bank a mural escarpment of considerable height, the face of which is colored with oxide of iron in large patches; hence the name painted rock. Towards the top the rock is stratified, and ledges extend along a part of the bluff, like the terraces already mentioned, and as these are not seen from below, the names inscribed for amusement on the face of the rock above the terraces excite the wonder of steamboat travellers, who are ignorant of the accessibility of that part of the precipice.

COAL ON SHORT CREEK, MARSHALL COUNTY.

From Gunter's Landing to Short Creek, the limestones of

this region are uncovered along the road in numerous places; but a more interesting locality occurs at Cave Spring. The Spring issues from a cave which is large enough to serve the purposes of a mill house, while the Spring, when dammed up, furnished the motive power for a grist mill, the remains of which are found in the cave.

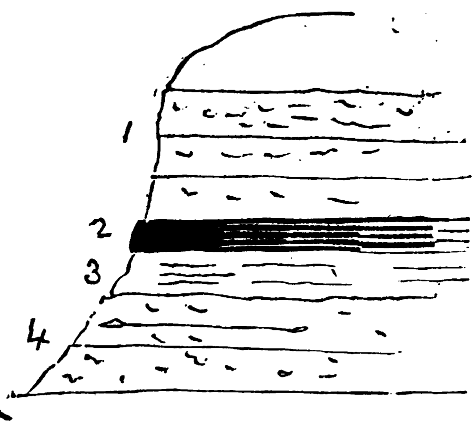
After leaving Gunter's Creek, the sandstone makes its appearance on the brow of the mountain, and continues uninterruptedly to the Valley of Wills' Creek, forming another of those vast sandstone table lands that I have already described as occupying the most elevated points in the State.

Short Creek, after cutting a deep channel in the horizontal strata of sandstone falls into the Tennessee above Gunter's Landing. About four miles above the mouth of the Creek, where the public road crosses, a wildly picturesque scene may be noticed by the traveller. The descent to the Creek is steep and rugged, as the road necessarily passes over the naked edges of the strata—on the left, the ruins of an old mill stand, that bear evidence of the force of the last freshet. The stream above the mill flows smoothly over the slightly inclined surface of a stratum of sand stone, which seems suddenly to have given way, and the water is as abruptly precipitated over the edge of the rocks, among the ruins of which it finds a wild and rugged way to the river. In a narrow gorge, about 200 yards below the mill, the stream has, by encroaching on the left bank, exposed a seam of very good coal 18 inches thick. It has been excavated, as is usual by persons having no skill in such operations, by undermining the overlying rock as far as their sense of danger from the falling of the impending mass will allow; for after the coal is extracted, as well as during the working, the roof is left unsupported. It is obvious that in this way very little can be done, and I believe that no attempt has been made beyond the supply of the blacksmith's shops of the neighborhood. Yet this bed is well disposed for mining operations, excepting

perhaps for the over-flow of the Creek; but I have no doubt that the out-crop of this bed will be found nearer the river, and at otherwise more favorable localities.

Fig. 5 shows the position of this bed.

(Fig. 5.)



1. A thick bed of sandstone forty feet thick, forming a good solid roof, that can be timbered without difficulty.

2. Seam of coal eighteen inches thick and of good quality. Nearly 200,000 bushels of coal have been taken from a bed of this thickness in the vicinity of Tuskaloosa, where the difficulties to be overcome were far greater than any to be apprehended here.

3. Bed of underclay two feet thick. This will greatly facilitate the mining, because it can be excavated beneath the seam, in the cutting of the heading, as well as the removal of the coal.

4. Sandstone, forming the bed of the stream.

I look upon this seam, thin as it is, as of considerable economical value, more particularly as the great productive coal measures of the State do not extend to the Tennessee Valley.

So little is known of the extent and thickness of the beds of coal in the Cumberland Mountains in Tennessee, that I am

unable to say how far the coal from Short Creek could be brought into competition with it on the river; at all events, it deserves a careful examination.

STRUCTURE OF PART OF DEKALB AND CHEROKEE COUNTIES.

From Short Creek a steep ascent leads to the top of the Racoon Mountain, in DeKalb county. In passing over this Mountain little would the traveler suppose that he was on the summit of one of the most elevated points in this part of the State, if he were not reminded by the rugged and difficult ascent. The top of the Mountain consists of a plane, unbroken even by the crossing of a stream, for a distance of ten miles. In no portion of the State have I observed finer natural pasturage than is found on the table land of De Kalb, I crossed the valley of Will's Creek, at Van Buren, and was not a little surprised to find silurian rocks developed here. I recognized the darkcolored limestones and yellow flagging stones of Turkey Town and Jones' Valley. A narrow ridge known as the Lookout Mountain separates this from the Valley of the Coosa. That part of Cherokee county, between the base of the Lookout Mountain and the Coosa, is composed of two ridges exteding parallel with the river, from Will's Creek where it crosses the Valley to the Blue Ponds. The ridge next to the Mountain is composed, beginning at the base, of the magnesian and colored limestones, succeeded by a bed of yellow and brown sandstone, in which the bed of red "fossiliferous ore" is contained; the whole dipping towards the North-West. This is evidently a continuation of the Red Mountain. The public road crosses this ridge at a low point, as it approaches Blue Ponds, so that the ore, which is finely exposed on the left, opposite the dwelling of T. SLADE, ESQ., appears on the right towards Yellow Creek.

The other ridge is composed of cherty limestones, and is low and undulating, separating the immediate Valley of the river from that known as Turkey Town Valley. There is

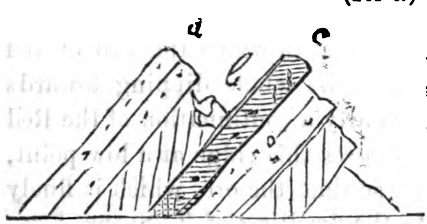
but little arable land along the banks of the river, and if we were to confine the Coosa Valley to this narrow strip, it would be narrow indeed compared with the size of this magnificent river; but the whole of the country to the Lookout Mountain properly belongs to it. It was pleasant to come again upon this interesting group of silurian rocks—a group including the most valuable mineral deposits of the State—thus far from its Southern extremity.

t will be recollected that this very remarkable bed of red hematite is found near Pratt's Ferry, on the Cahawba, that it occurs at Bucksville, from whence it was traced to Elyton; it is seen again above Gadsden, and now I find it on Yellow Creek; so that this valuable ore has been traced at intervals over a distance of one hundred miles, and still farther, as will be shown in another part of this report. A furnace has been erected here for the purpose of working this ore, a circumstance not a little gratifying, for when the survey was commenced it was scarcely recognized as an ore of iron.

The bed is about thirty to thirty-six inches in thickness, and lying in such a position as to have given rise to the opinion that the whole hill in which it occurs is composed of iron ore. It is, however, remarbably well situated for mining.

Its position is represented in Fig. 6.

(Fig 6.)



A.—Sandstone.

B—Clay Slate.

C—Red ore 30 inches thick. It runs up on the hill-side, which is strewed with fragments of ore.

It is enclosed between beds of sandstone, and overlaid by a seam of clay. On the whole this is a very favorable locality; the ore is of excellent quality, the forests are yet untouched, and the furnace is within three-quarters of a mile of the

Coosa, and one mile from the mouth of Yellow Creek. Add to these, that magnesian limestone in abundance occurs in the vicinity, which is best adapted as flux for this variety of ore.

Should this ore be treated properly, and the experiment prove successful, a revolution will be produced in the iron manufacture of the State.

A furnace has been erected to work the red ore of Round Mountain, in Cherokee, and is now in full blast. This is a matter of great interest, inasmuch as this ore had been scarcely recognized as such, before the commencement of the survey. The only difficulty experienced hitherto, is the high temperature required, and consequent consumption of fuel.

Mr. Stroup, the proprietor, has furnished the following statistics:

March 18th, 1855.

"Round Mountain Furnace was first put in operation in April, 1852, and has been in operation most of the time since. It has produced 2½ tons metal per day, and consumed on an average 650 bushels of Charcoal per day. A portion of the metal is converted into Hollow-ware and Machinery, which is sold in this State—the balance is run into Pigs, which finds a market in Georgia. The ore used is the red fossiliferous kind. It is taken from the side of the mountain, very near the Furnace, where it lies in strata from 10 to 24 inches in thickness; and is delivered at top of Furnace at 60 cents per ton. This ore, when properly treated, makes the best quality of iron for Castings and Foundry Pig.

"The Furnace is 32 feet high, 8 feet in the boshes, and driven by steam power—the steam generated by the waste heat of the Furnace—blown by a cold blast. The number of hands employed for all purposes connected with the Furnace is 45. It is only half-a-mile from the Coosa River, on which is shipped the pig iron to Rome, Georgia. There is an abundance of good limestone within a mile of the Furnace."

I traced the continuation of this bed, opposite Mr. Slade's, for the distance of one mile.

Another circumstance worthy of notice in this connection, is the abundance of excellent fire-proof stone, furnished by the mill-stone grit of the Lookout Mountain; that occurs on Yellow Creek, at the falls, and all along the ridge, parallel with the ore. Limestone for flux is everywhere present.

A short distance below the point where Line Creek crosses the public road, a hill of considerable elevation occurs, the slope of which exposes a fine section of the variegated limestone, a continuation of those on the Cahawba. It is unnecessary to enter into details here of this interesting locality; suffice it to say, that although the beds are not thick, some of the most beautiful specimens of variegated marble in the State are found here. I also found a thin covering of carbonate of copper lining the fissures in this limestone. At the foot of the hill, the black slate is found, and as if to complete the identity of this group with the rocks of the Cahawba, a bed of sulphate of barytes was observed at Greensport. This substance is well known as a substitute for white lead in painting, and has the advantage over white lead, that it is not subject to discoloration from the fumes arising from places where cleanliness is neglected. Separation from impurities and grinding are all the processes neceesary in its preparation for paint.

I was glad to learn that preparations were making to commence the business of lime burning on a large scale, at the fine limestone bluffs on the Coosa.

MINERAL SPRINGS OF NORTH ALABAMA.

The medicinal virtues attributed to some of the mineral springs of Lauderdale County, had excited a degree of interest in the subject that appeared quite extraordinary. Bailey's Spring, in particular has been noted for some years past for the number of remarkable cases reported to have been cured by the use of the water; and of its reputation abroad no better proof need be offered than that afforded by the crowd of visitors that assemble there not only from Alabama, but from the adjoining States.

The result of this success has been the careful search for mineral springs in every possible place, and as the springs of

greatest reputation in the county are not so very strongly characterized by their sensible qualities, su h as taste, smell, &c., as to remove them, in this respect far above all the rest, the number of springs discovered is very great.

Springs of every description have their origin in water derived from the atmosphere in the form of rain, snow or vapor. This percolating through the soil and fissures in the rocks, at length finds its way to the surface, and gives rise to springs. If the rocks through which the water percolates be purely siliceous or otherwise insolluble, the water will contain no foreigu ingredients, but will be nearly pure. The purity of the water derived from sandstones is due to their insolubility, and the excellence of the springs flowing from the beds of pebbles scattered over the State is to be attributed to a like cause. The nature of the rocks of a country must, therefore, evidently determine the character of the springs. In general, the water of springs of primary regions, where the rocks are composed of quartz, granite, &c., is pure. In limestone regions the water will contain lime, and where sulphuret of iron abounds the water will contain both sulphur and iron; but sulphuretted hydrogen may also result from the presence of organic matter.

Springs are divided into acidulous, alkaline, chalybeate, saline and sulphuretted waters.

Acidulous Springs derive their peculiar property from the presence of carbonic acid—hence the sparkling appearance they present when agitated, which disappears after boiling.

Alkaline waters contain an alkali either free or combined with carbonic acid; purely alkaline waters are rare.

Chalybeate waters c ntain iron combined with hydrochloric, sulphuric, and more frequently with carbonic acid. Chalybeate water is sufficiently characterized by its inky, styptic taste, and in general by the deep yellow deposit thrown down after the escape of the carbonic acid on exposure.

Saline Springs are those that contain salts, such as carbonate

of lime or magnesia, chloride of sodium, &c. Next to the chalybeate waters, these are probably the most common.

Sulphuretted Springs.—The sulphur in these springs exists in the form of sulphuretted hydrogen, which gives the peculiar order to the water, by which it is so readily recognized. The Indians, it is said, called these springs by the expressive name, "gun-powder springs."

The following are the substances most generally found in mineral waters:

Gaseous substances—Atmospheric air, (oxygen, nitrogen,) carbonic acid gas and sulphuretted hydrogen.

Acids.—Nitric, muriatic, sulphuric and carbonic, and hydrosulphuric acids, are those occurring in mineral waters, but with the exception of the last two, they very rarely occur in a free state, but combined with the alkalies and earths, forming salts.

The following are the principal salts that have been detected in mineral waters:

Carbonates of potassa, soda, ammonia, lime, magnesia and iron.

Sulphates of soda, ammonia, lime and iron.

Muriates of potassa, soda, ammonia and lime.

Hydrosulphurets of soda, and of lime, are not uncommon in sulphuretted waters. Iodine and bromine are found in some springs, and organic matter has also been detected.

Lauderdale county, as I have shown, is composed almost entirely of siliceous and cherty rocks, and it is from the disintegrated surface of these that the most noted springs of the county rise. That they flow near the surface is proved by the fact, that their temparature varies but little from that of the surrounding atmosphere, and is subject to similar changes, being warm in summer and cold in winter.

To account for the extraordinary effects of the water—effects, it was supposed, that could not result from the ordinary constituents of mineral water, and which must be referred to some

far more active cause—arsenic was supposed to be present, at least in one or two of the more prominent springs.

Although I attach but little importance to hasty qualitative examinations made in the field, still, as they may interest some, and as they were made with some care, a few are given till the more accurate analyses contemplated by the survey are ready to be presented.

BAILEY'S SPRING

Is situated on the head of a little branch descending from a high ridge bordering the valley of Shoal Creek, about nine miles from Florence. The surface rocks and those exposed on the Creek, belong to the lower group of the carboniferous rocks. The Spring, when I saw it in July, was not flowing boldly. The temperature was 68°, that of the atmosphere was 68°.8, and the temperature of an ordinary spring, not 100 yards distant from it, was 60°.8. The ingredients contained in the water are the following:

Free carbonic acid.	Carbonate Soda.
Carbonate iron.	Chloride sodium.
Muriate iron.	Carbonate Potassa;
Sulphur, combined.	

STEWART'S SPRING

Is situated one mile from Florence, and in the same geological formation as Bailey's. This watering place has been recently fitted up for the accommodation of visitors in a style in which both good taste and comfort have been consulted. The cottages are situated on the top of the ridge, at the foot of which the Spring rises. Its local advantages, including the agreeable society of the pleasant town of Florence, ought to make this a desirable place of resort. On June 30th, the temperature of the air was 77°, and of the Spring 71°.6. The temperature of a spring on the side of the creek, a short dis-

tance below, 62°.6. Ingredients contained in the water are as follows:

Free carbonic acid.	Sulphurretted hydrogen.
Chloride of sodium.	Carbonate of soda.
Carb. of magnesia, traces.	Alumina, traces.

A short ride from Bailey's a Spring has been opened, known as "Todd's Spring," in which iron is the prominent ingredient, but it also contains, in addition, other salts, and is said to have accomplished remarkable alleviations of disease. The temperature of a beautiful and copious Spring, just below this, was about 60°.

Lee's Spring is another of some reputation, although I believe no attempts have been made to accommodate invalids or other visitors by the proprietor. The Springs, which are two in number, are situated on the banks of the Creek, having on the right a gently sloping and shady hill. I saw here one witness who was ready to attest by his returning health the curative properties of this fountain. Along the road, between Florence and Waterloo, there are several Springs that contain iron and chloride of sodium, in sufficient quantity to place them under the head of mineral Springs. One of these occurs on the road near the residence of T. A. L. Lansford, Esq. And a little farther on an excellent chalybeate Spring occurs at a very pleasant place, the property of Mr. Witherspoon, and within a short distance of his well known and hospitable house.

I have already mentioned the geological position of Moore's Springs on Maple Creek. The peculiar stratum of black slate found among the silurian rocks of that locality marks the geological region of the mineral Springs of the United States from Saratoga to Blount's Springs.

The Spring is situated on the margin of the Creek, which flows rapidly by over its rocky bed. Limestone is exposed in thick ledges on the left bank, and the house for the reception of visitors stands upon a gentle slope on the opposite side of the valley.

In July the temperature of the air at the Spring was 71°.6 and of the water 68°. A qualitative analysis gave the following results:

Free carbonic acid.	Sulphuretted hydrogen.
Carbonate of lime.	Carb. of pottassa, traces.
Chloride of sodium.	Carbonate of iron.
Sulphur, combined.	

This is by far the most strongly sulphuretted Spring in this part of the State, and is only approached in this respect by the Spring on Limestone Creek. The free carbonic acid is also in considerable quantity. The distance from Athens is 12 miles only, and every arrangement of the place has in view the comfort and ease of the guests, so that it seems to me persons in search of health could make a pleasant sojourn during the heat of summer at Moore's Springs. The Spring on Limestone Creek rises from the same geological formation, and in general properties resembles the water of Moore's Springs. It was once a place of considerable resort, as is evident from the number of cottages surrounding the Spring; but watering places, like other matters dependent upon fashion, have their revolutions, and permanent patronage does not always reward the most deserving.

In Franklin County there are some noted Springs; one of these, the Franklin Springs, a sulphuretted Spring, has been long and favorably known to the public and needs no notice from me. I examined, however, a purely chalybeate Spring, which had just been opened, and found it contained, in addition to the iron, only a little lime.

About two and a half or three miles from this, the very interesting saline Springs, known as "Ligon's Springs," occur, which have been opened for the reception of visitors within the last few months. The position of these I have already described. The houses are placed on the top of a pretty high ridge, exposed to the full influence of currents of air from every side. The temperature of the air at the Spring, June 26th, was 74°, and that of the Spring 72°.5.

The constituents of the water are:

Free carbonic acid. Chloride of sodium.

Sulphate of iron. Sulphate magnesia, trace.

On the same stream, but a little higher up, a chalybeate Spring is found, which contains muriate and sulphate of iron, together with free carbonic acid. This is, I apprehend, among the strongest saline Springs in the State, and for that numerous class of diseases arising from deranged digestive organs will be found highly beneficial.

On the ridge towards the upper edge of Walker County, there are some chalybeate waters, one of these is at West's, and another at a well known place of summer retreat, Doctor Davis'. It would be difficult to find a more salubrious climate than that enjoyed by the inhabitants of this part of the State.

RECAPITULATION OF THE GEOLOGY OF NORTH ALABAMA—INCLUDING THE VALLEY OF THE TENNESSEE.

1. *Silurian Rocks.*—On Maple Creek, in Limestone County, a bed of blue limestone is exposed, which is a continuation of the rocks of the silurian basin of Tennessee. In the eastern side of Jackson County, on the banks of the Tennessee, where the devonian and carboniferous rocks have been removed, a variegated limestone containing but few fossils occurs, which may be referred to this group. On some of the other streams that flow from the north into the Tennessee, silurian rocks are exposed; but the rocks of this region have not been studied with sufficient care to enable one to separate the silurian from the devonian series.

So rapidly do the whole sink towards the South that they scarcely reach the Tennessee at more than one or two points.

2. The devonian rocks are represented by the black slate which is found on all the principal streams that flow from the North into the Tennessee, between Flint River, in Madison County, and Shoal Creek, in Lauderdale. This rock, which

is quite uniform in lithological character, is composed of dark colored argillaceous slates, often sufficiently bituminous to burn with flame. It varies in thickness from 20 to 60 feet. As yet I have found but a single fossil, a small lingula, which has been observed in Kentucky by OWEN and NORWOOD, in the same rock. Supposing this to be the upper stratum of the devonian system, we have an excellent and well-marked horizon from which to commence the study of the carboniferous rocks.

3. In North Alabema, at least, the division of the carboniferous rocks made by TROOST, is sufficiently characteristic and definite to be still retained. The lower cherty beds he denominated the siliceous formation, as distinguished from the overlying calcareous beds.

The lower beds are best seen at the Muscle Shoals, which are caused by the indestructible character of this rock. It is a dark colored chert, resembling flint, and is quite poor in fossils. Notwithstanding its great hardness and density, it is subject to disintegration, and passes from this hard slate to a fine silicious powder.

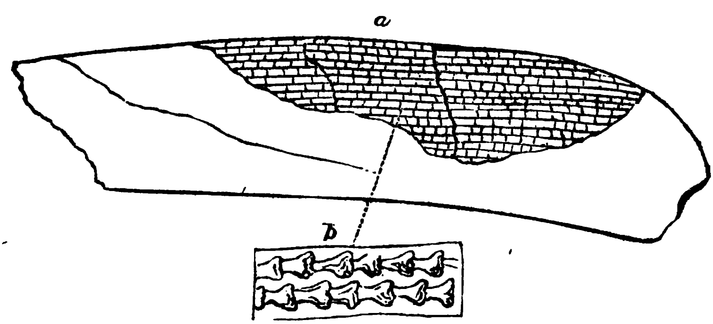
The height of the Shoals is 85 feet, and as they are composed entirely of nearly horizontal beds of this rock, the total thickness of this lower member of the carboniferous strata may be safely estimated at 100 feet.

In the valley of Shoal Creek, north of Florence, a little stream, the Cowpen's, flows over the edges of the cherty rocks as it enters the Creek from the South. The black slate forms the bed of the Creek at this place, and a race for a saw-mill has been excavated in the strata overlying the slate. The rock along the race passes from chert into a calcareous sandstone, much subject to disintegration. The stems of *Platycrinus Saffordii*, of unusual size are found in considerable abundance in the debris thrown from the race. At the saw-mill the rock becomes hard, greenish in color, and presenting in parts a peculiar sub-crystalline structure. It contains

about 14 per cent. of phosphates derived from the remains of fishes which are scattered through the rock. Amongst these I was so fortunate as to detect an *Ichthyodorulites*, having a portion of the enamel with its characteristic markings still remaining. It belongs to the genus *Ctenacanthus*, and is closely related to *C. tenuistriatus Agass.* of the carboniferous limestone of Bristol. Of this genus there are known eleven species, of which only one belongs to the devonian system, the rest being found in the carboniferous rocks, of Europe. *Platycrinus Saffordii* occurs in Illinois, in the Warsaw beds, and taken in connection with the occurrence of this Ichthyodorulites, leaves no doubt of the fact that the cherty rocks, next overlying the black slate, belong to the carboniferous system.

Fig. A represents this fossil which I have called *ctenacanhus elegans*.

(Fig. A.)



a. Represents the fossil of the natural size, with a portion of the enamal remaining.

b. A magnified view of a part of the enamel, showing the jointed character of the stria, which resemble, in this respect, the fine rays of certain cartilaginous fishes, the Ray, &c.

It may turn out to be identical with *C. tenuistriatus Agass.*

4. Overlying the siliceous group is a conspicuous bed composed of impure and often of coarse grey crystaline limestone containing an immense number of stems of crinoids, which

often make up entire beds. This is the encrinital limestone of TROOST. It varies in thickness from 12 to 50 feet.

Near the Woollen Factory on Cowpen's Creek, as well as near Huntsville, a thick stratum of coarse crystalline limestone, containing *spirifer striatus* in considerable numbers seems to occupy the same horizon as the encrinital limestone. Above this is a bed abounding in *Pentremites florealis* and *pyriformis*, with the remains of fishes; amongst the latter, teeth of *Psammodus* and *Cladodus* are conspicuous. These genera are characteristic of the mountain limestone of Europe.

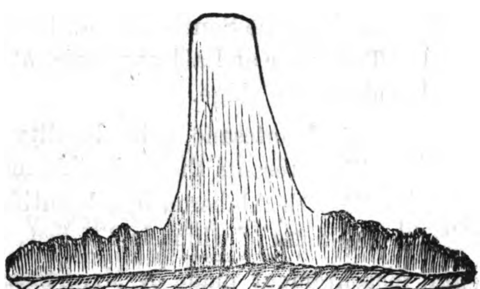
(FIG. B.)

C. Newmani—Outer Surface.

Fig. B. represents a species which I have called Cladodus Newmani. It is exposed on the weathered surface of a fragment of limestone, so that only one side of the tooth is seen. It was found, as was the following, by DR. NEWMAN, of Huntsville.

Another fine specimen is represented in the cut, Fig. C.

(FIG. C.)

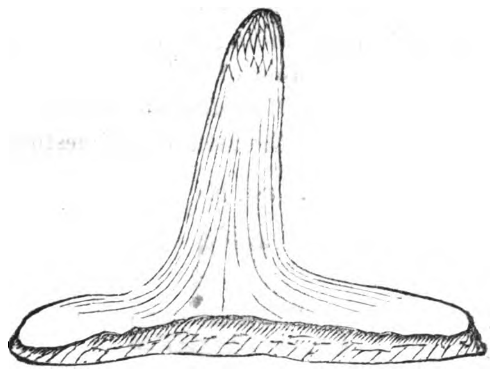


C. Magnificus—Outer Surface of Tooth.

The rock has split in such a manner as to expose both sides of the tooth.

Fig. C (a) shows the inner surface.

(Fig. C. a.)



C. Magnificus—Inner Surface.

Fig. C (b) shows a vertical section, with the expanded inner portion of the base or root:

(Fig. C, b.)

5. About the middle of the series of beds of limestone, there occurs, near Huntsville, a bed of sandstone, the surface of which is covered with impressions of fossil plants of the coal period. This is still better developed on the South side of the valley of the Tennessee at LaGrange, and at other points along the ridge.

6. Montesano, a fine locality near Huntsville, presents the carboniferous limestones of North Alabama in a beautiful series, the thickness of which is 875 feet, according to an instrumental measurement made by Mr. Steele, the Engineer. If we add to this, the thickness of the lower siliceous

beds, we get a total thickness for the carboniferous rocks of North Alabama, of nearly 1,500 feet.

Towards the West the calcareous beds thin out, and are finally covered by the cretaceous rocks of Mississippi.

7. The South side of the Valley presents the counterpart of these strata. Towards the top of the series, in Lawrence, there is a bed of bituminous limestone, from which exudes liquid bitumen, or "mineral tar." It is also found solid, and in some quantity, as I am informed.

TAR SPRING OF LAWRENCE.

Tne following account of this Spring was furnished by Mr. POWELL:

"The Tar Spring is situated in Lawrence county, nine miles South of Oakville, near the county line of Hancock and Lawrence, now the property of PAUL J. WATKINS, a planter of Courtland, who has purchased the same recently for a summer residence. The Spring was known to the hunters and early settlers as a resort for deer; it was improved as a watering place by JOHN PRICE, about the year 1840, who kept the place up some four or five years, during which time it became popular as a watering place, and was known far and near for its curative properties; it was a known cure for Scrofula, Cancerous Sores, Rheumatism, Dyspepsia, and other diseases in which alteratives are required. The water runs out from a seam or crevice in the limestone, and the tar, or bitumen, floats on the surface, a black film very cohesive and insoluble in water. The tar can be collected in masses: and patients visiting the Spring find the tar taken and swallowed as pills, the most efficient form of the remedy. The tar has been found secreted in a similar form and consistency in crevices of the limestone near the Spring. The country around for several miles is very broken, and the atmosphere pure and healthy. Chalybeate Springs are very abundant. Lime tone is found at the base of the hills, and brown, soft sandstone at the tops. Conglomerate masses of quartz and vegetable petrifactions abound. Coal is not found upon the surface, but is supposed to exist in great quantities from the waters and mineral formation.

The Spring is upon Capp's Creek, which empties into the Bushy Fork of Sipsey, section 26, township 8, range 6, West.

The Tar Spring is located about 50 feet below the top of the limestone; but within this limestone, at 30 feet above the Spring, is found a bed, eight feet thick, of yellow ferruginous sandstone of an open porous nature, very rough and rugged."

8. Beds of magnesian limestone, and strata of limestone having an oolitic structure are found forming a conspicuous part of the rocks of North Alabama, an interesting point of identity with the carboniferous series of Europe.

The following table represents the temperature of some of the principal limestone Springs, so common in this part of the State, and may have some interest:

NAME.	TEMP. OF AIR.	TEMP. OF SPRING.	DATE.
Monte ano, Madison County	80°.6	55°.4	July.
Marmion, Limestone County	95	57 .6	June.
Evetts, Franklin County	62 .2	58 .1	....
Factory on Cypress Creek,	68	58 .55	....
Bran-dance Spring, Lauderdale County	71 .6	59	....
Hartstone, Bluff Creek, Lauderdale County	75 .2	59	....
Landsford's Spring, Lauderdale County	89 .6	59	....
Spring near Cypress Creek Bridge	80 .6	59 .35	....
Athens Town Spring	93	59 .4	....
Franklin Spring, Franklin County	74 .2	59 .8	....
Simpson's Spring, Lauderdale County	95	59 .8	....
Bold Sp'ing, near Todd's Spring	80 .6	59 .8	....
Great Sp ing, at Tuscumbia	75	60 .8	....
Great Spring, at Huntsville	80 .6	60 .8	....
Johnson's Furnace, n ar Athens	69 .8	61 .60	....
Capt. N. Davis, Limestone County	69 .8	61 .60	....

The temperature was taken with a standard thermometer accompanying Walferdin's Maximum Thermometer.

Chapter Second.

General View of the Structure of the Metamorphic Rocks—Section from Wetumpka to the Falls of Tallassee—Flagstones—Graphite—Soapstone—Tallassee to Silver Hill—Blue Creek Deposit Mines—Notasulga—Itacolumite at Farrell's Mills—Limestone Springs—Limestone of Macon County—Yonge's Quarry and Kilns—Colquitt's Quarry and Kilns—Echols' Quarry and Kilns—Reese's Quarry and Kilns—From Auburn to Oak Bowery—Searches for Copper—Opelika to Girard—Iron Ore—From Lafayette to Horse Shoe—Morgan Gold Mine—Goldville—West Point, through Chambers and Randolph—Pinetucky Gold Mines—Wood's Copper Mine—Chulifinnee Gold Mines—Abacoochee Mines—Chulifinnee to Lundy's Mount—Stringfellow's Mine—Talladega Springs to Soccapatoy—Stewart's Gold Mine—Coosa Gold Mines—Hatchet Creek Deposits—Granite of Coosa and Tallapoosa.

METAMORPHIC ROCKS OF COOSA.

It was stated in a previous report, that the metamophic rocks terminated at Wetumpka. Beds of gneiss, passing into mica slate, occur here in great force. The edges of the strata rise up boldly from the bed of the river, but are covered by drift on the banks. The rock is coarse, splits with ease, but the bedding planes are uneven. The strike is North-East and South-West, and the dip 75° North-West.

Turning East above the Penitentiary, and passing over the undulating surface of the drift, to where the road crosses Coon Creek, below the ford, a ledge of rock is seen, which resembles that of Wetumpka, excepting that it is rendered porphyritic by flattened crystals of pink fedspar, that lie between the laminæ of mica. Although coarse, this rock is strong, and the contrast between the color of the feldspar and the black mica gives it an agreeable appearance. The crys-

tals of feldspar are compressed, and interlaced by the mica; the rock may be called a porphyritic gneiss. At this locality, another bed of white gneiss occurs. It resembles very much the rock at Tallassee, both in color and compactness, and it would make an excellent building material. Although no quarry is opened, the rock may be examined at the ford. With the exception of the denuded beds of streams, the rest of the country is composed of drift, covered with one unbroken pine barren, to the Tallapoosa.

Above the falls of Tallassee, the river is wide, and divided by little islands into numerous channels which unite near the barrier of gneiss, which crosses the stream in a direction nearly East and West. The pent-up water has forced a passage through this natural dam, and foaming amonst the vast masses of rock, sends its spray to the winds. The gneiss is fine grained, and compact, but not thick bedded. Immediately at the falls the strata are worn into pot-holes, some of which are eight feet in diameter. The water, often pouring into these, finds an outlet between the strata, which in time are completely undermined, and in this way most of the huge masses lying around have been broken off from their original beds. The entire fall, at the Factory at the foot of the falls, is sixty feet. In summer, when the banks are fringed with green and beautiful shrubs, this place presents a scene of picturesque wildness, that will repay the labor of a visit.

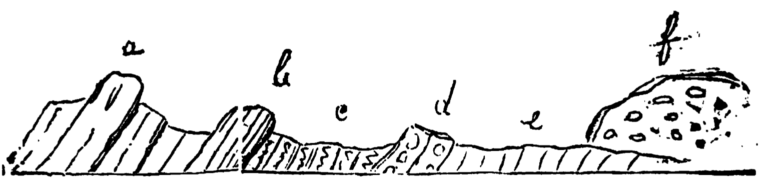
On the right, the valley is quite narrow, and a well located road, exposes on its side, the beds of drift which rise to a height of 200 feet above the river.

It would be difficult to conceive of a more favorable locality for manufactories, on a large scale, than this. The whole of the river is precipitated, through a narrow gorge, over a fal of 60 feet, and in a distance of 8 miles the river falls 400 feet. The Factory recently erected here, at a cost of $30,000, presents a fine example of the adaptation of the rock of the falls to building purposes.

On the side of a little stream called Slone's Mill Creek, which empties into the river below the falls, the gneiss becomes slaty, and excellent flagging stones could be carried. Although such materials are found elsewhere in the State, I know of no locality so favorable as this.

The first falls on the river occur two miles South of Tallassee, at the site of the old Indian village of Tuckabatcha. The river, after following the metamorphic rocks till they are covered to a great depth by the drift, turns directly West to join the Coosa, four or five miles below Wetumpka.

(FIG. 7.)



Section from Tallassee, on the bed of the River, to Tuckabatcha.

a. Beds of gneiss, forming the Tallassee Falls, strike East and West, dip towards the North 40°.

b. Flagging stones finely exposed on Slone's Mill Creek: course of the joints which intersect the quarry North 20° West.

c. Mica slates.

d. Thick strata of slates with bosses of felspathic and coarse crystalline granite protruded through them. Rounded masses of quartz are found embedded in the slates, and when the latter are worn away, they rest on the surface like large boulders.

e. Micaceous and talcose slates, containing lentiform nodules of graphite between the slates, which abound in garnets. The graphite, when divested of the slate, is very pure, but unfortunately the pieces in which it may be procured are not

very large. These strata extend across the bed of the river, and as the banks are covered with alluvium, can only be seen at low water. The locality requires a more thorough examination than I could give it at the time of my visit.

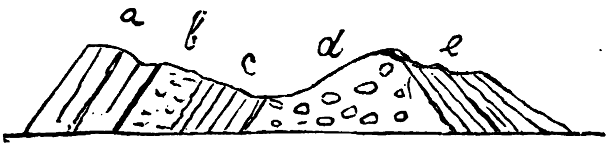
f. Beds of drift.

North of the falls the rocks become talcose, and on a little stream, called Coon Creek, beds of hornblende and soapstone occur. In a hollow, near the creek, a bed of soapstone of great thickness is found. This seems to have been well known to the Indians, who resorted to the spot for the purpose of manufacturing culinary utensils. Excavations, of considerable extent were made in the best portions of the rock, and the sides of the excavations are curiously pitted where the vessels have been cut out. It appears to have been their practice, to inscribe on the rock the circumference of the pot or bowl to be cut out, and then to excavate around it until a sufficient depth was attained, after which the mass was split off and finished. Occasionally, when failure in splitting off the mass ensued, pieces remain attached to the rock. Everywhere the impression of the bottom of the vessel is left on the face of the quarry. The rock is calcareous, effervescing with acid. Crystals of pyrites are abundant, but no other minerals, excepting actynolite and talc, are found here.

These Indian excavations have deceived many inexperienced persons, who supposed that they were made for the precious metals. The soapstone of this locality extends across the county into Chambers, and at intervals throughout this extent it is perforated by such excavations.

This is the locality which excited so much interest as the Tallapoosa Silver Mine.

(FIG. 8.)



Section on Coon Creek.

a. Gneissoid rock extending to mouth of the Creek.
b. Sienitic gneiss, with flat crystals of hornblende.
c. Hornblende slate.
d. Soapstone, 100 feet thick, outcropping on Penn's land.
e. Hornblende.

The strike of the rocks, in this section, is South, South-West, and North, North-East, dip of the bed at *e*, South, South-East, and of the gneiss at *a*, North, North-West.

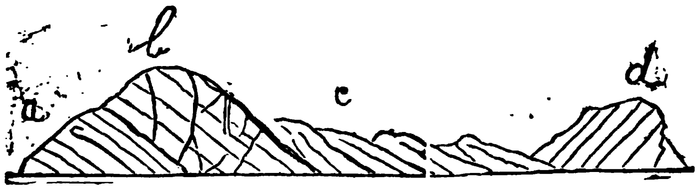
From this point to Silver Hill hornblende slates are every, where displayed, with the exception of the occasional occurrence of beds of gneiss, as may be seen on the Sougahatchee, where that rock passes into talcose slates. The course of the rocks here is North-East and South-West, dip 40° North-West. The country is composed of rounded hills, covered with the warm brown soil common to hornblende rocks. Such soils suffer from excessive drought, but for the production of grain they are amongst the very best.

SILVER HILL GOLD MINE.

The talcose slates of Silver Hill are seen out-cropping near Ufola, and the gold mine occupies the crest and flank of the hill which extends to the stream on which the mill is situated.

The auriferous slates are enclosed between beds of hornblende. The following section will show the position of the mine:

(Fig. .9)



Section of Silver Hill.

a. Hornblende slate.

b. Auriferous talcose slate, with veins of quartz.

c. Dark colored talcose slates.

d. Hornblende slates.

This section is best seen at the base of the hill near the mill. Both *a* and *b* are quite hard, when placed beyond the influence of atmospheric agencies.

About ten years ago this mine was in its most prosperous condition. About 150 feet of the principal vein was found out-cropping on the crest of the hill. It was 2 feet thick; but, about 12 feet below the surface it became thinner and richer; at a depth of 15 feet it became poorer. It again thickened to 4 or 5 feet, and continued to improve in productiveness until it was abandoned.

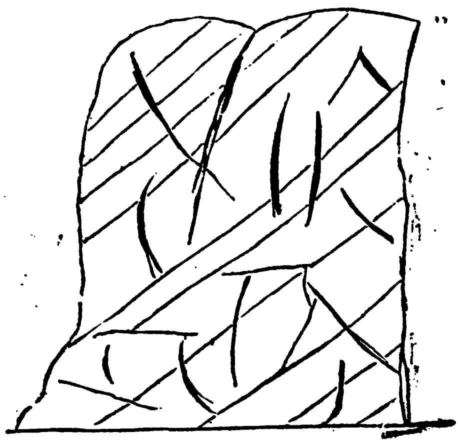
The vein, which was quartz, was worked to a depth of 80 feet in the centre, where it was richest. The ore was there worth $4 85 a bushel. The course of the vein was a little North of East. The usual mode of letting out the mine in small parcels was adopted here, and with the same results as elsewhere—the total ruin of the works. The vein is situated in Section 16, Township 20, Range 22.

It has been recently re-opened with some prospect of success. An adit has been driven a little above the natural drainage of the Creek, with a view of striking the vein below the old works. Whilst this heavy work is going on, the proprietors are working some ore from the top of the hill. The ore is hauled by oxen about 250 yards to the mill, where I found 6

stamps, and a badly constructed Burke Rocker, in operation. The ore thus treated yielded only 12½ cents per bushel.

The principal vein was not exposed at the time of my visit; but some of the auriferous portions of the country, which were worked, presented the appearance shown in the cut, Fig. 10.

(FIG. 10.)



The dark lines represent broken quartzose veins containing gold. On the branch, into which the drainage and surface water flows, signs of old works occur in the gravel deposited in its bed. MR. LIEBER, who examined this place more recently, reports as follows:

"The Silver Hill mines, which were formerly abandoned on account of difficulties among the members of the company, are now worked by a Georgia company, with a prospect of success.

"The country is a talcose slate, one of the beds of which is of that peculiar black kind resembling black lead. Another talcose bed, in which quartz appears in irregular masses, is the one which is worked, the slate being also auriferous. This bed strikes North 70° East, and dips 15° to 35°. A quartz vein

leading from this, and striking North, is about 12 feet thick, including the selvages and workable slate. The main body is 8 feet thick. Deeper down, the quartz will consolidate, in all probability, into a regular vein. Garnets and peroxide of iron occur, but all mixed up confusedly with the slate. The black and grey slates are not auriferous, whilst the red, and portions of the white slates, are.

"The present company have driven two good adits, one of which is 400 feet in length, which, by draining a large amount of untouched ore, will enable them to win the contents of the mine for a long time, without any additional expense of consequence for drainage. The gold is said to be worth 95 cents per dwt."

On the opposite side of the branch, an immense series of quartz beds comes to the surface, which *beds* are more or less auriferous, and have even been worked, but with great difficulty, owing to the distance from water. They occupy the crest of a hill of considerable elevation, towards Blue Creek, forming an interesting feature in the landscape. On the tributaries of the Creek, a great amount of gravel has been washed, in years past, for gold, and with much success, but these works have been abandoned years since.

FROM SILVER HILL TO NOTASULGA,

The route lay towards Walnut-hill, where the soapstone, already mentioned, occurs, and a trap dyke on Section —, Township 20, Range 22, at Johnson's, the course of which is North 40° East. The whole country around is underlaid by hornblende rock, and hence the fine brown soil. Nothing, surely, prevents this portion of Tallapoosa from being a great grain-growing country but the difficulty of transportation to market. It is really striking to see so fine and healthful an agricultural region so thinly settled.

The Sougahatchee seems to be the northern limit of the drift, in this part of the State.

Everywhere there was great talk of silver, especially in the vicinity of the old excavations in the soapstone, but nowhere the slightest evidence of its existence.

On a little stream, a tributary of the Sougahatchee, a fine section in the mica slates is exposed at Ragan's Mill, and a very interesting trap dyke occurs here also. The course of the dyke is North and South. The strike of the mica slates is North-East and South-West, and the dip 45° towards the North-West. The slates occasionally pass into itacolumite, and sometimes become felspathic, and by decomposition produce porcelain clay.

After crossing the Sougahatchee, from North to South, the drift begins to accumulate, and at Notasulga the beds of this formation are in such force as to hide completely the metamorphic rocks, excepting where they are laid bare by the denuding action of the streams. At Tony's Mill, about 4 miles from Notasulga, the mica slates are finely exposed in the bed of the branch.

The most remarkable locality of the rocks under examination is at Farrel's Mill, on the Techoctafalee, a branch of the Ufoupee. Where the road crosses, below the tail race, the bed of the stream is strewn with prismatic fragments of stratified quartzose rock, that is recognised at once as itacolumite. On the left bank of the pond it rises up into a bluff of considerable height, with sharp projecting ledges, bearing a strong resemblance to an immense pile of silicified wood. At the dam, above the saw-mill, it may be seen with all its characteristics finely presented. It is grooved and striated on the surface of the bedding planes, and is intersected by joints in such a manner as to produce very regular rhomboidal prisms, which are piled up like masonry. It is quite hard and compact, with but little mica, and hence it is difficult to find flexible specimens. The fall from the top of the upper dam, to the saw-mill, is 52 feet. The strike is North 30° East, the dip 30°, and the course of the principal joints North 50° West.

This rock was first noticed by HUMBOLDT, in South America, where it is associated with diamonds. In a survey of a part of Georgia, made for DR. DANIEL, by MR. F. SCHREIBER, it was again found; it also occurs in South Carolina, in two distant localities, Pickens and Spartanburg Districts, as well as in North Carolina, and it is worthy of note that, both in Georgia and North Carolina, a few diamonds have been found in the gold washings where this rock occurs.

In Spartanburg it runs parallel with the limestone of that district, and it is found here occupying the same position.

LIMESTONE OF MACON COUNTY.

In an economical point of view this limestone is highly interesting. It extends across the county in a North-East and South-West direction, and therefore, occupies, geographically, a position intermediate between the limestone, of the cretaceous formation on the South, and that of the silurian rocks of the North-Western part of the State. Its proximity to the Railroads of Eastern Alabama also invests it with more than ordinary interest.

Higher up the stream than the itacolumite locality, just described, some bold limestone springs are found issuing from the banks; but the country is so completely covered with drift, that it was impossible to discover additional evidence of the limestone which undoubtedly exists below the surface.—This, it is probable, is the South-Western extremity, so far as it is indicated on the surface, of the Macon limestone.

When a stratum of limestone, or other destructible rock, occurs between strata that are less destructible, of course it suffers most when subjected to any denuding force, and hence it is, that the limestone, under such circumstances, is found occupying the bottoms of vallies.

The first locality to be noticed is that known as Yonge's Quarry, situated in Section 4, Township 18, Range 27, and

about one mile and a half from the Opelika and Girard Railroad. The strike of the bed is North, North-East and South, South-West, it is nearly horizontal, and appears to be the top of one of those flexures so common in the rocks of this part of the State; for the strata dip to the right and left of the trough-shaped depression in which the limestone is found. It is associated, wherever it is exposed, with the same rocks—itacolumite, mica slate, and hornblende rocks. The itacolumite is found on a ridge to the West, and the hornblende occurs East of Colquit's. Here, as at other localities, the limestone is cut up by joints and fissures, the joints corresponding in course with the strike. At several points it is found protruding through the loam which constitutes the soil of the valley. It is more or less crystalline, and varies in color from white to blue. The following are analyses of the limestone of this locality:

1. *This is a yellowish white limestone, rather soft and crystalline.*

(Composition in 100 parts.)

Carbonate of lime	55.07
Carbonate of magnesia	42.94
Alumina and oxide of iron	.25
Insoluble matter	1.39
	99.65

2. *White and highly crystalline.*

(Composition in 100 parts.)

Carbonate of lime	55.42
Carbonate of magnesia	42.95
Alumina and oxide of iron	.40
Insoluble matter	.19
	99.96

3. *Blue and granular.*

(Composition in 100 parts.)

Carbonate of lime	55.16
Carbonate of magnesia	44.22
Oxide of iron	.44
Insoluble matter	.79
	100.61

The kilns are situated very conveniently, advantage having been taken in their location, of a lime sink which brings their tops nearly on a level with the ordinary surface, at the same time that the burned lime below is quite accessible. The kilns are three in number, and hold respectively 400, 450 and 600 bushels.

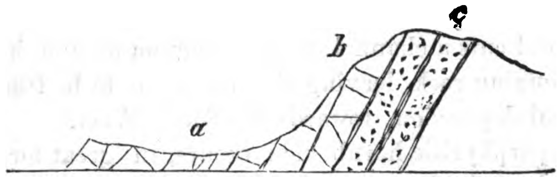
MR. YONGE, who is conducting the business with great energy, employs 7 hands at the kilns, and 3 or 4 teams in the business of transportation; but the opening of the Opelika and Girard Railroad must relieve him from the latter heavy tax, and enable him to supply, not only Columbus, but the entire trade of the Chattahoochee, with cheap lime.

Columbus is distant about 23 miles from the kilns, and lime is furnished (July, 1854) at 55 cents a bushel.

As I have already stated, a slightly depressed valley indicates the course of the limestone; and although it is not easy to estimate precisely the thickness of the bed, there can be no doubt of its ample dimensions, for it is found outcropping at a distance of 300 or 400 yards across the stratum.

On the head waters of the Uchee, about one mile and a half to the North-East of this, Colquit's Quarry is found. Here, as at the other localities, the rock occurs in the valley; but it also rises into the hill-side. In the bottom it is white marble. The numerous joints, by which it is intersected, prevents its application to any other purpose than the manufacture of lime.

(Fig. 11.)



Section at Colquit's.

a, Limestone exposed in the valley.

b, Limestone rising into the hill, a thick stratum which is quarried.

c, Quartz rock.

The stratum on the hill-side offers great convenience for quarrying, and greatly lessens the labor of raising the limestone to the top of the kiln.

Specimen from Colquit's quarry, very white and crystalline seems identical with 2. *from Yonge's Quarry.*

(Composition in 100 parts.)

Carbonate of lime	55.48
Carbonate of magnesia	44.04
Alumina and oxide of iron	.33
Insoluble matter	.09
	99.92

Associated with this limestone, is a beautiful pink mineral, which seems to be a kind of indurated talc. It has not, however, yet been found in quantity.*

At Dowdell's Mill, a fine stratum of hard and tough hornblende rock has been excavated for the wheel-pit and race, and is similar to that associated with the limestone; but I was unable to find any traces of the latter, until I reached Echol's Mill, higher up the Chowochala.

*For analysis see Dr. Mallet's Report.

About a mile North of the mill, the limestone is found in the valley of the Creek; but suddenly the Creek turns to the right, and cuts a channel at the junction of the hornblende and adjoining rock, leaving the limestone to be traced along the usual depression, towards the South-West.

The porphyritic hornblende occurs, in great force, at the mill, where it rises into a high and picturesque hill, both at the dwelling of the proprietor, and still higher up stream.—On the right bank, below the mill, the itacolumite rises into prominent ridges, and I observed also a bed of mica slate running parallel with the limestone. The limestone is exposed on the left bank of the Creek, above the mill-pond.

The mica slate will be found useful in the construction of kilns, and where it is found soft and schistose in structure, it will be sufficiently fire-proof to answer for the lining, where nothing better is found.

The kilns are placed at the tail of the saw-mill, a most convenient position as regards the important item of fuel, as the refuse slabs may be used for this purpose; but this advantage is almost entirely lost in the bad construction of the kilns.

The stratum of limestone is 200 yards in thickness, and may be traced, from this point, at intervals, over a distance of 2 miles. It is confined to a long depression towards the North-East, and in the opposite direction it is found in the bed of the Creek, as high up as the quarries of Mr. Reese. It is, for the most part, covered by a bed of loam, and wherever it is exposed it is deeply eroded and water-worn. The white crystalline part of the rock is really good statuary marble; but so completely is it cut up and fissured, that it can only be used for the manufacture of lime. Other portions of the rock are grey, and sometimes of a blue color.

The following is the composition of the rock at this locality, which is within 3 miles of the Railroad, at Auburn:

Limestone from Echol's Quarry.

(Composition in 100 parts)

Carbonate of lime	56.07
Carbonate of magnesia	41.84
Peroxide of iron	1.04
Insoluble matter	1.64
	100.59

Mr. Reese's Quarries were examined by Mr. Thornton, who speaks thus of them:

"The lime kilns, the property of Mr. Ed. Reese, are situated about three and a half miles South-East of Auburn, and one mile and a quarter above Col. Echol's Quarries, and on the left bank of the Chowochala, East of the quartz rock. The Creek runs along the Western edge of the limestone, which is from 200 to 250 yards in thickness. To the East of the limestone, mica slate is found out-cropping beyond the quartz rock. A ferruginous sandstone is found on the summit and sides of the ridge and is used in the construction of kilns. The color of the limestone veins varies from deep blue to pure white. It is exposed in several places, coming up in the little bottoms in the form of cones. It is also found out-cropping on the hill-sides, and such localities are chosen for the quarries. Masses of siliceous matter occur in the beds. There are two lime kilns, holding 500 and 600 bushels. Seven hands are regularly employed; one making barrels, one hauling wood to the kilns and lime to Railroad, and the rest quarrying and attending to the kilns. The stone is quarried and placed in the kiln in a week, and the time required for calcining a charge is three and a half days.

"The kilns are made by excavating on the hill-sides a space of the required form and size, which is lined with sandstone. They are broad at the bottom, and gradually decrease in size towards the top. The Montgomery market is supplied with

lime from these localities at a price of 50 cents per bushel.—The cost of transportation on the Railroad is 8 cents per bushel."

The ferruginous sandstone, mentioned above, is composed of grains of sand cemented by iron. It is an abundant and useful material, and is sufficiently fire-proof for ordinary purposes. It is seen, in large masses, on the road leading from Auburn to Echol's Mills. The hornblende and quartz rock are also found out-cropping around the town.

LIMESTONES FROM REESE'S QUARRY.

1. *A yellowish grey limestone.*

(Composition in 100 parts.)

Carbonate of lime	59.33
Carbonate of magnesia	38.39
Alumina and oxide of iron	33
Insoluble matter	1.81
	99.98

2. *This is a whiter and more crystalline specimen.*

(Composition in 100 parts.)

Carbonate of lime	54.57
Carbonate of magnesia	37.93
Peroxide of iron	2.24
Silica and scales of mica	5.05
	99.79

The Montgomery market is principally supplied with lime from the kilns near Auburn; but, since the opening of the Opelika and Girard Railroad, Mr. Yonge also disposes of a portion of the product of his kilns at that market.

It will be seen that the Macon limestone is very uniform in composition, being a true dolomite or magnesian limestone. This rock is noted for the whiteness of the lime, as well as for the excellence and hardness of the mortar produced from it,

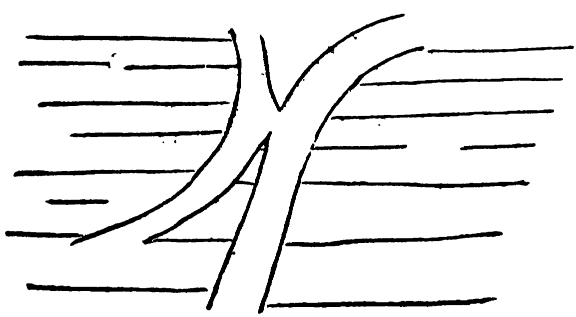
which is often more or less hydraulic. These desirable qualities are, I believe, fully established by experience in those cities where this lime is much used.

The great want in this branch of industry is well constructed kilns, which, besides lessening the expense of production, would greatly improve the quality of the lime. Still it is pleasant to know, that a better day is slowly, but certainly, dawning upon our industrial pursuits.

AUBURN TO OAK BOWERY.

From Auburn to Oak Bowery, the rocks passed over are mica slates for some distance, then gneiss, succeeded by hornblende slates. Within two miles of the latter village a fine dyke, of coarse felspathic granite, is seen on the road-side.

(Fig. 14.)



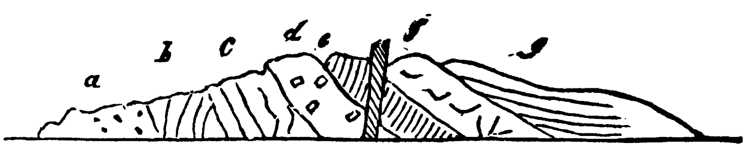
Granite Dyke, near Oak Bowery.

From this point up the ridge, hornblende slate is the prevailing rock. Near the village, and at Mr. Sandford's Chalybeate Spring, a fine stratum of this rock is seen, rough and decomposed on the surface; and near his dwelling an interesting trap dyke forms a conspicuous object. East of the village, some excellent beds of soapstone, interstratified with hornblende rocks, were pointed out to me by Dr. Thomas. The excavations in these beds show that they were known to the aborigines.

In the vallies could be seen the results of the disintegration of the felspathic rocks in the form of white clay, approaching, in some instances, porcelain clay. Around the village fine opportunities are presented for studying the influence of rocks upon the soil. The grey soil, so favorable to the growth of cotton, derived from the felspathic rocks, may be seen, side by side with the warm brown or mulatto soil of the hornblende. The curiosity with which everything was examined that looked at all suspicious, showed that I was approaching the imaginary copper region. I examined some beds of poor bog iron on a little stream, and other deposits colored by iron.

About 3 or 4 miles from the Bowery, I found a shaft in progress in search of copper. As this presents an instructive example, I give a section of the rocks :

(FIG. 15.)



a, Beds of quartz rock, which is quite granular, and produces on the surface a coarse white sand.

b, Hornblende slate.

c, Gneiss, nearly vertical.

d, Bed supposed to contain copper.

e, Hornblende.

f, Coarse felspathic rock.

g, Gneiss, nearly horizontal.

The stratum at *d* is a porous, siliceous rock, abounding in iron, and somewhat resembling what the Cornish miners call "gossan," and which at 'Ducktown' (Tenn.) leads to copper. On pursuing this stratum downwards, as the water level was approached, the surface of the rock became beautifully colored with what mineralogists call the "iris tarnish," and which

an unskilful observer might easily take for the peculiar color of variegated copper. When it is recollected how much more attention men pay to resemblances than to differences, it will not appear surprising that a mistake should have occurred here. There was on the top what appeared to be "gossan," and below the color of a certain variety of copper.

As the water level was reached, the stratum changed completely; what was on the surface loose ferruginous matter, now became a white porous and hard quartz rock, studded with bright cubic crystals of iron pyrites.

The explanation of this phenomenon will appear under the head of copper in another part of this report.

It is unnecessary to say that, owing to the good sense of the parties concerned, operations were discontinued here before any serious expense was incurred.

Near MR. ANDREWS' vast and rugged masses of hornblende passing into soapstone are found protruding above the surface, and not far from the house a trap dyke crosses the road, with which I found associated magnetic oxide of iron, but not in great quantity.

Magnetic oxide of iron, from Mr. Andrews', above Oak Bowery.—This ore is of a dark grey color and acts but slightly on the magnetic needle. Like all the magnetic ores found associated with trap dykes, it is titaniferous.

(Composition in 100 parts.)

Peroxide of iron	61.37
Sesquioxide of titanium	9.21
Protoxide of iron	28.80
Magnesia	:08
Alumina	trace
Silica	54
	100.00

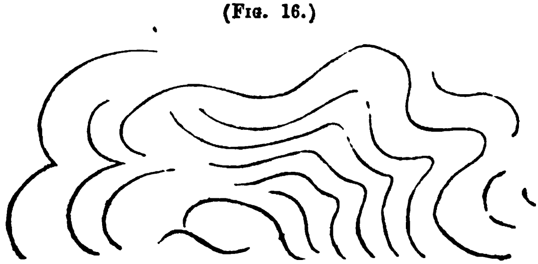
Metallic iron..............................65.36

OPELIKA TO LA FAYETTE.

On the Opelika and Girard Railroad fine sections of talcose slates are seen in the newly made excavations. The slates are bent, thrown over, and otherwise curiously contorted.

The accompanying cut will give a correct idea of these disturbances.

(FIG. 16.)



Between Opelika and Mt. Jefferson the rocks are principally coarse micaceous slates, with an occasional bed of coarse gneiss, approaching granite. The soil is grey, as usual upon such rocks. Mt. Jefferson is a most beautiful site for a town, but as it is a mile and a half from the Railroad, Opelika must, of course, prevent its growth.

Nothing can exceed the beauty of the oak-crowned ridges of this region. One of these extends nearly the entire distance to the pretty and thriving town of LaFayette.

Immense strata of hornblende, enclosing a bed of soapstone, occur on the Osanape; the rest of the way is over the alternating edges of hornblende and mica slates. The constant disintegration of the hornblende rocks gives rise to accumulations of oxide of iron, which differs from bog iron ore deposits, in being found on the hill-sides and even tops.

Near the town a spring issues from the rocks, which holds in solution sulphur, iron, lime and traces of soda, the sulphur being the prominent ingredient.

About 7 miles West of LaFayette a trap dyke comes to the surface. The dip of the rock is 40° towards the South-East. The same series of rocks is found along the road-side to West Point. This village is situated on the Georgia side of the line, and on the first terrace from the river. Bluffton occupies the brow of the next terrace, which is composed of drift made up of large pebbles, sand, &c. I found on the left bank of the river numerous trial shafts, sunk in search of copper, and one especially interesting, being sunk on a trap dyke.

On the lands of Mr. Geo. Reese, a quarry has been opened on some fine ledges of hornblende rock, which furnished the material for the abutments and piers of the Railroad bridge across the Chattahoochee.

Near Mr. Reese's dwelling, fine specimens of magnetic oxide of iron were picked up in a cultivated field. Their size and fracture showed that they were portions broken off from a vein in the underlying rock, but no excavation had been made for its discovery.

FROM LAFAYETTE TO THE HORSE-SHOE BEND, ON TALLAPOOSA.

The country between LaFayette and Dudleyville is somewhat broken. On Chatahospa Creek, six miles and a half above LaFayette, hornblende rock, with a stratum of diallage, is spread out on the bottom of the Creek. The fall here is about 15 feet.

From Fitzpatrick's to Dudleyville the rocks become slaty; the village stands upon a bed of gneiss. Beyond the village two shafts were sunk in search of copper. One was induced by a vein of cellular quartz, that once contained iron pyrites; and the other is in a trap dyke, on the side of which was cut a vein of asbestos and talc, one foot thick. Parallel with these slates is a noble bed of soapstone, the strike of which is indicated by numerous Indian excavations.

On the way to the Morgan Gold Mine, on Tallapoosa, a powerful trap dyke was examined, at Perry's Mill, and further

on the soapstone is excavated, to a greater extent than I have seen elsewhere. These quarries must have been worked for ages. Numerous unfinished and broken pots and bowls were found here.

Everywhere at the South, fragments of soapstone vessels are found with other Indian remains; but Alabama is the only State in which I have met with these excavations. It would appear that a considerable trade was carried on at these localities.

Morgan Mine.—This is situated on a branch very near the river. It is a deposit mine, composed of a thick bed of coarse gravel. Some veins in the neighboring rocks appear to be auriferous. The mine was just opened at the time of my visit and was attracting much attention.

On the road from Dudleyville to the Horse-shoe-Bend, there occurs a series of rounded hills, made up of talcose and talco-micaceous slates, that are in several places auriferous, and were once worked. The gold occurs in thin quartzos veins stained by oxide of iron.

Near Deshon's Mill, a mine, now the property of MR. FITZPATRICK, was once worked with some success.

A soft black carbonaceous slate, which is mistaken for graphite, was shown me by MR. STONE,—it gives a black streak which wants the metallic lustre of that of graphite. It may, however, answer the purpose of an anti-friction composition for machinery.

Goldville Mine.—The gold mine of this place was discovered in 1842, and was worked to water level. The most noted portion of the mine was known as the tog pit; the richest part of the vein in this pit was from 4 inches to 2 feet thick—it was quartz in talcose slate, and yielded 2½ dwts. to the bushel of ore. The gold was worth 90 cents to the dwt.

Almost $30,000 worth of gold was extracted from this pit, and from this the proprietors received in addition $80 00 in silver.

The history of this mine is like that of all Southern gold mines—the total want of any practical system of operations.

This mine, Mr. Lieber reports, has been recently re-opened: "A vein has been discovered which, from its curious contortions, is called the 'snake vein.' In the South side of the shaft it is poor, but in the Northern side it yields, on an average, one dollar per bushel. The ore is a friable, porous, ferruginous quartz. The country is talcose slate, decomposed as far as yet reached. Numerous other veins appear on the same property, and properly managed success may be anticipated. The minerals found here, besides gold, are magnetic iron-sand, native sulphur, garnets, and mica."

Rocks on the Eastern side of the State from West Point, through Chambers and Randolph.—Between West Point and Fredonia, the prevailing rocks are hornblende slates, inter-stratified with an occasional bed of gneiss.

The country is undulating, and covered with the reddish brown soil, characteristic of the hornblende rocks. Fine examples occur here of the effects of physical agencies on soils. At Mr. Hill's, I saw a hornblende soil that had been in cultivation 20 years without being manured, whilst an adjoining farm, much broken, has been worn out and almost abandoned. I also observed here fragments of magnetic oxide of iron scattered in such a manner as to indicate that they were the ruins of a vein.

A few miles from the village, beds of impure soapstone are found coming to the surface in rough irregular ledges. In several places the old excavations found in these rocks have given rise to the opinion that they are the work of ancient miners after the precious metals. It is really wonderful to observe the tenacity with which these notions are held.

I visited, with Col. Hill, of the Military Academy, a locality at Rock Spring, that excited no small amount of interest. This was a supposed silver mine.

The rock of the country is a greenish hornblende, which at

the mine, passes into actinolite, and contains crystals of carbonate of lime.

A bold spring issues from a fissure in the rock, which, is itself an interesting object, but there was not the slightest reason to expect an ore of any sort here, much less one of silver.

Between Fredonia and Mill Town, the country is greatly broken, but there is little change in geological character.—At Brombelow's Cross Roads, I examined numerous specimens brought from a distance, as copper ore, or indications of such; but I was sorry to be obliged to disappoint the expectations of those who brought them. The only thing of any value that I found was a specimen of per-oxide of manganese of good quality.

About half a mile from Brombelow's, a sudden change takes place in the soil, which is due to a stratum of gneiss which crosses the country and produces a grey soil, which contrasts strikingly with the darker colored hornblende soil.

Approaching the village, I saw a quarry from which a coarse soapstone had been taken.

The most interesting geological feature of Mill Town, however, is the vast and smooth expanse of gneissoid granite, near the town, where it terminates in a bold escarpment, and extends back almost horizontally, and covers at least 200 acres. It is weathered smooth, and intersected by joints as straight as a line; their course is North 40° East. On the surface, in places, the rock seems to separate in layers a foot or eighteen inches thick, as if by exfoliation. These layers are easily split, and consequently building materials are obtained here with the greatest ease.

Wherever a depression occurs in the rock, a little soil accumulates, and numerous moisture-loving plants make their appearance.

On the edges of this immense mass, large fragments split off by their own weight when undermined by disintegration.

Fragments are also left nicely balanced, as if on a point, and are almost converted into rocking stones.

For a half mile North of the town, quartz beds of great extent occur. The hornblende becomes more slaty, and immediately at the Randolph line, it is succeeded by talcose slates. On reaching this line it is easy to see that one is about to enter the auriferous region of the State.

The slates are nearly vertical; strike North-East and South-West. Near MR. POOL'S, evidences of the existence of gold are pretty strong, and at MR. HANSON'S, not far from this, some excavations have been made, but I did not learn the result. Kyanite and garnets are both found in the slates. The slates continue within 7 miles of Wedowee; a change in the soil shows the existence of hornblende below the surface.

At Wedowee, MR. WILEY MIZE showed me a good specimen of peroxide of manganese, which I trust he has since found in quantity. It is a hard species of manganese known by the name of psilomelane, and contains 63.25 per cent. of peroxide of mauganese.

Above, or to the North of Wedowee for some distance, talcose and micaceous slates; but on Piney Creek, around Smith's Mill, fine exposures of a coarse granite containing large crystals of feldspar and plates of mica.

Pinetucky Gold Mines.—Between Piney Creek and Pinetucky, the country is quite hilly and composed of mica slates, and beds of talcose rocks.

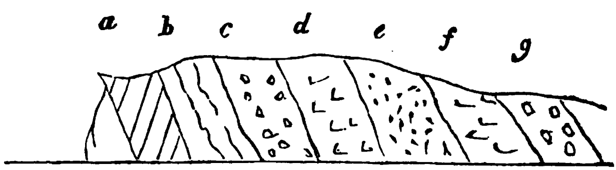
Pinetucky is among the old gold localities of the State; the gravel on the surface, as well as the veins, was worked extensively. The slates are of that sort, that on the surface disintegrate easily and present a homogeneous mass of colored talcose matter. The old works it was impossible to examine. The mine has passed into the hands of a new company, and operations were just begun at the time of my visit.

This mine occurs on Sections 12 and 13, Township 18, Range 10.

Wood's Copper Mine.—The rocks here are very similar to those travelled over between Piney Creek and Pinetucky, excepting that, on the East, rounded dome-shaped hills extend into elevated and continuous ridges. One of these runs parallel with the road leading to Abacoochee, and is rather famous for the copper explorations made upon its summit and sides. Near the Southern extremity, and on the West side of this, Wood's Copper Mine is situated—Section 31, Township 17, Range 11.

The diagram (Fig. 17) will show the mode of occurrence of the copper here.

(Fig. 17.)



Section at Wood's Copper Mine.

a, Hornblende slates.
b, Talcose slate.
c, Copper bearing slate.
d, Syentusah.
e, Quartz rock.
f, Hornblende slate.
g, Talcose slate and garnets.

The copper was first discovered here, in a little branch near the mine, in the form of a carbonate, which resulted from the disintegration of the sulphuret of the metal. Parallel with the stream a trench was cut, which showed copper disseminated through the rock for several yards, in the state of yellow and purple sulphuret, with some green carbonate of copper. A vein of red oxide of iron was cut, which, it was hoped, would terminate in a copper lode; but the constant run from

the branch, without the simplest mechanical means of freeing the pit from water, caused the abandonment of this place.—Another trial shaft was sunk, and the copper still found only disseminated through the rock, and no lode was cut to the water level, when this was also abandoned. Although hard specimens could be found here, sufficiently rich, yet no considerable portion of the bed was found workable.

On the top of the ridge just mentioned, I found parties at work, in sinking upon beds, supposed to be cupriferous. In one place a narrow vein of brown hematite was cut in open excavation in the slates. The ore on the surface was taken for gossan, but strange tc say, when cut it was not followed, but the excavation was carried below it.

At the next place there really was nothing to induce the slightest trial—not even iron ore—excepting the opinion of an ignorant workman from Ducktown. A mile or two beyond this, some really instructive phenomena occur; but well calculated to deceive persons not accustomed to observe accurately. The rocks dip into the hill towards the East, and are covered but sparingly with soil. The surface water easily cuts a channel through this, and lays bare the under-lying rocks. These abound in iron pyrites, which is constantly undergoing decomposition, and yielding a porous oxide of iron, which is dissolved out and precipitated on the surface of the rock, in the form of what may be called a ferruginous tufa. In two or three places, this substance has been taken for copper gossan, and some expense incurred in exploring it. This subject will be taken up again, in the section on copper.

At the foot of the ridge in question, a fine bed of iron ore, about three feet thick, composed of a rich brown hematite, was opened, but not excavated to any extent.

Chulifinnee Gold Mines.—This place is situated on the South side of the talcose ridge which runs along on the Northern verge of the silurian rocks. Numerous trial shafts for copper have been sunk here, on beds of no greater promise han those on the ridge.

The gold mines are found within a few miles of the village. They consist of deposits, and at a short distance some compact quartz veins have been laid bare, which have on the surface of the joints a thin film of gold. These veins have not been worked, but the deposits have been rudely turned over, and it is probable that they would be more productive now than when first opened.

About a mile from the village, an extensive deposit of similar character is found, the property of H. H. WICHE, ESQ., of Talladega. The gravel and clay, of which the deposit is composed, are spread over an area of 240 acres. I found a single hand, with a common Rocker, at work. The gold was coarse, and judging from what I saw, energetic and judicious efforts here would meet a proper reward. The only apparent difficulty, at the time of my visit, arose from scarcity of water, a difficulty, however, that was not confined to this locality. It is found on Section 23, Township 7, Range 9, East.

Abacoochee Mines.—This is by far the most extraordinary deposit in the State, it extends over an area of six or eight hundred acres, on the top and sides of an elevated point, and at one time gave employment to 600 men. It is situated in Sections 5 and 6, Township 17, Range 17. Nearly three years have elapsed since any work of consequence was done here. One or two persons had recently resumed their labor, not in the gravel beds, but in the soil of the hill top. After the soil was worked over, three feet of the subsoil were found to be auriferous. It is a red loam derived from the decomposition of the underlying slates, and not at all disturbed, as is seen by the quartz veins by which it is intersected.

About 40 cubic feet of this yields about $25 00. The mode of working is most original. On the surface, shallow trenches are dug 12 feet apart and 30 feet in length. Into these trenches water is admitted from a small canal; a few ounces of quicksilver are thrown into the trenches, the loose auriferous

earth is also thrown in, and the gold, as it is carried over the quicksilver, by the water, is taken up. After a while the miners shut off the water, and beginning some distance down stream, pour out the amalgam. Rude as this method is, it is in much repute amongst the miners, who prefer it to more expensive methods.

The slates of this mine belong to the auriferous band in which Pinetucky is found.

COUNTRY FROM CHULIFINNEE TO LUNDY'S MOUNTAIN.

The best results of the energetic search for copper, that pervaded this part of the State, are the uncovering and bringing to light, so many beds and veins of iron ore, many of them of great interest and value.

From Randal's Bridge, along Fish-head Creek, a fine strip of hornblende rock is found, extending into the Hillabee country, where it is so altered as to resemble a light green basalt, retaining, however, its stratified structure. It is marked in its course by the usual dark colored and excellent soil. The prevalent rock, however, is mica slate. At CANADA'S, a fine and bold ridge rises up, composed of thick bedded slates, intersected in a few places by veins of iron ore, one of which on the out-crop consisted of pieces of ore. The ruins of the vein near the surface were explored, but the vein itself, although the accumulated fragments appeared great, was only a few inches thick, and escaped notice when it was cut in the shaft. At other localities towards Delta, iron pyrites seemed to excite great suspicion. At Delta, a remarkable stratum of slate full of large garnets was also an object of interest. Some miles East of Delta, I examined, as far as it could be examined, a bed of white marble. It is seen where it is water-worn. Prominent points come above the water of the stream, in which it occurs. It underlies the bed of the stream, and is 50 or 60 yards thick. This must, one day, be of great value, when the country becomes

more thickly populated and means of transportation more easy.

Four miles from Lundy's Store, I found several excavations made, where there was not the slightest reason for expecting anything valuable.

Descending towards Candutchky, an old Indian town, the hornblende rocks are again seen. It was not a little interesting to find at this site of an old Indian settlement, marks of good judgment and taste in its selection that I have frequently seen displayed elsewhere. The town was situated on an elevated spot, sloping gently on all sides and surrounded by richly wooded hills. The soil has for its foundation hornblende slates, and although in cultivation since the time of its Indian proprietors, is still capable of producing a good crop. The settlement is in Sections 14 and 15, Township 20, Range 7.

On a ridge in the neighborhood, a party was occupied in "testing" a vein of iron ore that intersected the slates.

Stringfellow's Mine.—The mine known by this name occurs a few miles from Candutchky, in a country composed of mica slates and gneissoid rocks.

This is, perhaps, one of the most interesting points yet explored for copper in the State, more especially as it presents nearly the same association of minerals as that found at Ducktown. A particular account of this mine will be found in the section on copper, further on.

A mile South of Candutchky, a bed of pure oxide of manganese crosses the road, which may be traced along its out-crop by the fragments found on the surface.

Crossing over the ridge, elevated towards the Eastern side of the metamorphic rocks, a fine deposit of brown hematite occurs. The ore is, as usual, in a red loam, and is found in a bed 40 feet wide and two miles and a half in length. It occurs on the land of the Rev. I. B. Seay, Section 35, Township 6, Range 18. It is from this bed that Riddle's Iron

Works are supplied. It is also found on the land of C. W. Roby, Esq. A stratum of limestone is found on Section 27, of the same Township and Range.

FROM TALLADEGA SPRINGS TO SOCAPATOY.

Talladega Springs are situated near the junction of the silurian and metamorphic rocks, and at the foot of a ridge of considerable height. This ridge has along its crest a thick stratum of quartz rock, that becomes laminar, and when thin, slightly flexible, like itacolumite. The flanks of this ridge are composed of slates, dipping towards the East, and what is remarkable, they overlie the newer silurian rocks. On the opposite side of the ridge a limestone valley runs parallel to the ridge. This valley is a continuation of that in which the Syllacogga marble occurs.

Following the valley, one mile below Peckerwood Creek, I found a stratum of white and bluish marble; where it was exposed it seemed to be about 20 feet thick. The white is rather veined or clouded, but the bluish marble is quite handsome. To the West of this, the talcose slates are present, in force, in a series of rounded hills, and of such a character as to indicate a true gold region.

Stewart's Gold Mine.—This old mine is in Section 4, Township 23, Range 17. The auriferous portion of the ridge is about 200 feet wide, and was at first worked in open cut; but the ridge has been perforated by shafts, at intervals, for a distance of one-half mile. This mine was worked for some time with stamps, but has long since been abandoned.—Masses of bronze colored pyrites are scattered amongst the refuse—they seem to be portions of a vein cut in the mine, and are more or less auriferous.

The Weoguffka mountains are composed of talcose slates, which are finely presented at the point where the Weoguffka Creek crosses the Rockford road. About 33 miles above

10

Wetumpka the ridges assume a greater elevation, and from their tops the broken character of the country may be seen.

The country is covered with a magnificent forest of long-leaf pine, which, when seen from above, present a peculiarly rich and luxuriant appearance. The talcose slates are succeeded by mica slates, which continue till they pass into the gneissoid rocks, near Rockford.

On the way to Rockford I examined a curious locality, where immense masses of ferruginous matter occurred on the surface, and excited hopes that they would turn out to be copper gossan; and a shaft was sunk under the supposition that the "gossan" would be cut at the proper depth below the surface. But, unfortunately, those masses were formed in the same manner as the ferruginous tuxa of Randolph, and did not extend below the surface at all.

Near Rockford, on the land of C. W. Chancellor, there occurs an auriferous deposit of gravel and clay, a portion of which was once worked.

Of the gold mines of Coosa, Mr. Lieber speaks as follows:

"The old mine, near Mr. Griffin's, in Coosa, occurs in Range 27, East, Township 23, Section 4. The works having fallen in, nothing is now to be seen. It produced well at one time, and an engine was mounted on the spot, but want of skill, together with mismanagement, prevented success.

"The auriferous gravel deposits of Alabama present some very peculiar and interesting features. It would be difficult to circumscribe them with regard to their geographical occurrence, since gold is found, in greater or less quantity, in almost all the gravels and sands of the Creeks and branches of the metamorphic region, extending even as far South as the Tallapoosa, 20 miles East of Wetumpka, where traces of gold exist.

"The deposits of the Weoguffka and Hatchet Creeks, in Coosa county, demand, perhaps, the greatest attention.

"On Messrs. Thos. and Sam'l Lambert's places, in Coosa,

some of these beds occur, and a fine opportunity is afforded for observing them. The "packed gravel," as it is locally termed, immediately underlies the soil and debris of the surrounding rock, and is usually about a foot or 18 inches in depth. The beds contain a large amount of clay, so that their unctuous touch serves to distinguish them with the hand even under water, from the dry debris which overlies them. The quartz of the gravel is throughout of an orange color, of a kind I have not seen in any other auriforous region. It belongs to that compact granular quartz, commonly called "sugar quartz," and is probably identical with that which, in Australia, has received improperly the name of "cairngorm." It is worthy of remark, that I have but in one solitary instance found this peculiar quartz in place, though making its discovery a matter of careful attention. This was at Mr. Richmond Noel's, in Randolph county, Sections 4, 5, 8 and 9, Range 10, East, Township 22. The bed is here 2 feet thick, and holds a position between a bed of gneissoid eurite, containing, however, a little white mica, and a body of gneissoid granite, which is the same as that at Hunter's. It crops out in the bed of a branch, whose gravel has been found to be auriferous. The quartz, when newly broken, resembles lumps of good brown sugar. The color is pale lemon within, and orange without. Occasionally pieces are seen which pass from a blood red to a deep claret color, and on the fresh break exhibit correspondingly redder tints than the other.

"To return to the gravel deposits of the Weoguffka :—the largest quartz boulder observed contained about 4 cubic feet. All these, from the smallest to the largest, are much rolled, although the larger ones are not so much rounded and still roughly indicate the original forms of the broken pieces. In these gravel beds we rarely meet with pieces of the slates, gneiss, &c., which are found so abundantly in the dry and not gold-bearing beds covering them, and where no powerful action has tended to round the constituent pieces of rock. I

am inclined to believe that ZERRENNER errs in enumerating gneiss as one of the rocks found in the auriferous gravel of Alabama. The specimen had probably fallen in from the upper beds.

"Occasionally the deposits widen to 150 or even 300 feet, but always depend upon the width of the little vallies. Owing to these depositions the surface of the ground in the vallies is singularly level, and has afforded space for the accumulation of very good soil. Branches are found in some, but not all, of these vallies.

"The gravel pans from four to twenty particles of saveable gold of a fine color, and there is scarcely a doubt, but that, if suitable locations were selected and proper contrivances chosen for extracting the gold, very profitable operations would be the result, especially when we bear in mind the greasy nature of the gravels, in consequence of which only the very coarsest particles of the metal are saved in panning. The utmost attention should be paid to this fact also in the treatment on a large scale.

"The Hatchet Creek deposits include what is termed the Miller Gold Mine, in Section 1, Township 24, Range 20, East, and another close to it in Section 11, of the same Township and Range. The former, or old Miller Mine, usually paid about $1 75 per hand, the latter only $1 00. The former was last worked in 1847, by T. PHILLIPS, of Nixbury, with 6 or 8 hands, and averaged, during the summer, from 75 cents to $1 00 per hand per diem. The ground worked is extensive, and we find upon it both gravel beds and decomposed talcose and micaceous slates with interspersedmasses of itacolumitic quartz. Both were worked, and the operations were all exposed to-day, so that now all is in confusion and decay. As many as 50 hands were engaged here, at the same time, in the summer of 1843. The operations were commenced in 1840, but frequent interruptions took place, and indeed these mines were only resorted to when no other employment presented itself.

"The gold was of a very superior quality and better than that at the old mine, which was formerly worked near the Weoguffka.

"This spot, if properly managed, might yet be made very productive, and indeed the old gravels might again be worked over to advantage; as a proof of which it may be proper to state that, in the summer of 1854, a man engaged in this occupation quite alone, and made over $1 00 a day, by the roughest treatment. Ill health prevented his continuing.—MESSRS. MCELRATH BROTHERS, of Cherokee county, now own two-thirds of this mine.

"The whole valley seems to be auriferous, for a MR. FORD, an old resident of the neighborhood, now of Texas, sank many pits about, and found only one in which he was unable to obtain gold.

"It has been already stated that it is impossible to point out all the occurrences of deposit gold in Alabama, and it is almost as difficult to ascertain all the localities at which it might be profitably worked, especially as it may require a long time before a really efficient treatment can replace the present barbarous processes. Future discoveries, too, will probably develope far more than it is possible to show at present."

The country around Weoguffka and Hatchet Creeks is doubtless the most broken portion of the State occupied by the metamorphic rocks—yet in the vallies the soil is good and productive.

GRANITE OF COOSA AND TALLAPOOSA.

Around Rockford large weathered masses of a whitish gneissoid granite are found on the surface; sometimes immense fragments are undermined and broken off by their own weight.

On the way to Bradford, I saw another trial shaft, sunk, I believe, in search of silver. There was really no reason to expect any profitable result from exploration here. The shaft

was sunk on a bed of coarse slate abounding in rough garnets. It is true, that mica slate containing garnets, is a promising metalliferous rock; still we must have some positive evidence of the existence of some valuable metal in the rock before we commence expensive operations. The rock in question contained the merest trace of copper, not more than one might expect to find in any of the rocks of this region.

At Bradford, gneiss is finely exposed at the factory, where it is cut up into prisms by joints running North, 20° East, across the stream; the fall here is 35 feet. A mile farther up, it becomes more granitic, and rises above the surface, in the manner of the masses at Rockford. On the surface it is weathered, sometimes inclined to disintegration, and where it is felspathic produces a fine porcelain clay; this clay I found excited interest at some of the mines. At Mr. S. S. Graham's the rock is hard, very white, and rings to the hammer. It would be difficult to find a more beautiful building material. It belongs to the great gneissoid granitic belt that extends along the Northern portion of the Southern States. It is seen again at Blake's Ferry, on the Tallapoosa. In hand-specimens, and even the largest masses exposed, it presents no appearance of stratification; it is, notwithstanding, interstratified with mica slates, has the same strike and dip, and must therefore be called gneissoid granite.

The plank road, to a distance below Powellton, passes over the disintegrated edges of gneissoid rocks, with only here and there a bed of hornblende. The grey soils of this region owe their excellence, for the production of cotton, to the underlying rock. The physical features of the country are also favorable; the surface is undulating, but not broken.

On Chenahatchee a very peculiar gneissoid granite occurs, in which the mica is not regularly distributed through the rocks, but occurs in small patches, contrasting curiously with the white feldspar of the rock.

Chapter Third.

Silurian Rocks of Shelby, Benton and DeKalb—Montevallo to Columbiana—Clay Slates of Buxihatchee—Red Ore near Columbiana—Fire-proof Stone—Section through Cherokee and DeKalb—Chockolocko Creek—Boiling Spring—Oxford Iron Ore—Lead of Benton—Porcelain Clay of Benton—Lead at Griffith's—Baird's Iron Ore—Ball-Play Mountain—Explorations for Lead—Cedar Bluff—Gaylesville to Spring Creek Valley—Lover Falls of Little River—Mining for Silver.

From Pratt's Ferry a series of greyish red slates may be traced across the country to the Coosa. This forms the substratum of a very remarkable soil, which differs materially from the soil of the clay slates of the primary rocks. The slates are inter-stratified with beds of limestone, the disintegration of which must have produced a decided effect upon the soils of this region. The reddish whetstones, now so generally known and valued throughout the State, are in these slates.

About 10 miles from Montevallo, some fine strata of limestone, compact in structure, and resembling the rocks at Pratt's Ferry, are crossed by the Railroad. The business of lime burning has been commenced at this locality, for the first time in the State, in a proper manner.

SLATES OF BUXIHATCHEE CREEK.

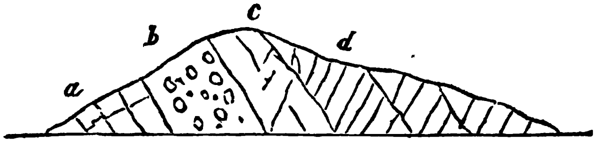
The slates of this locality rise up into a bold bluff on the right bank of the Creek. The mass is intersected by joints; these are favorable when not too numerous. The color is grey. The rock is quite fissile, but as no excavation was made it was impossible to ascertain the value of the slates that might be

procured here. A quarry of roofing slates of good quality is a desideratum of some importance, and the indications here were quite sufficient to induce the proprietors to make a thorough exploration of the quarry—the only means of determining its value. This, it is hoped, has been already done.

Red Iron Ore.—On a ridge, near Columbiana, a bed of this ore is found, overlying a conglomerate which forms the crest of the ridge and extends from within a mile of Columbiana to Beeswax Creek. It is quite different from all the red ores o the State. It is more compact, and so intersected by joints, that the fragments scattered on the surface present a decided prismatic structure. So completely is the bed broken down at the out-crop, that it was impossible, with the means at hand, to determine the thickness of the bed; but I have no doubt that it is quite considerable.

The position of this ore will appear from the accompanying (Fig. 18:)

(FIG. 18.)



a, Limestone. This is the limestone exposed on Beeswax Creek.

b, Conglomerate, that may be suitable for mill-stones.

c, Red ore.

d, Clay slates.

Red hematite, from Columbiana.

(Composition in 100 parts.)

Peroxide of iron	76.87
Sesquioxide of manganese	.51
Silica	20.74
Alumina	1.55
Phosphoric Acid	trace
	99.67
Metallic iron	53.81 per. ct.

The limestone associated with this ore, and exposed at the base of the ridge, on Beeswax Creek, is very accessible, easily quarried, and will make excellent lime. The bed from which the following specimens were taken can be easily recognised by its dark color.

Analysis of the Limestone from Beeswax Creek.

(Composition in 100 parts.)

1.	Carbonate of lime	90.52
	Carbonate of magnesia	4.93
	Peroxide of iron and alumina	.49
	Insoluble matter	4.35
	Carbonaceous matter	trace.
		100.29

(Composition in 100 parts.)

2.	Carbonate of lime	90.43
	Carbonate of magnesia	4.28
	Peroxide of iron	74
	Insoluble matter	4.30
	Phosphoric acid	trace.
	Carbonaceous matter	trace.
		99.75

As the Railroad passes through this locality, it may one day yield lime for less favored parts of the State.

Fire-proof Stone.—On LOCKHART'S ridge, I examined a bed of a fine grit, that will answer for a fire.proof stone. It occurs again on another part of the same ridge, about three miles from the Railroad, and about four and a half miles North of Columbiana. On Walnut Ridge, a similar grit is found.

A limestone quarry has been opened in an impure limestone, at Sholson's Spring, which shows the adaptation of the rock to the construction of heavy masonry. The joints that are seen through it greatly facilitate the quarrying, and its even bedding planes require but little dressing. The quarry is near the line of the Railroad.

SECTION THROUGH BENTON, CHEROKEE AND DEKALB COUNTIES.

From Chulifinnee to Oxford, the way lies over a broken country of talcose slates, which terminate towards the North-West in a bold ridge, to which I have given the name of Chockolocko Mountain. This mountain may be examined on the road leading from Chulifinnee to White Plains, and still higher up at Defreese's Mill, where it trends North-East into Georgia, forming the Western boundary of the metamorphic rocks.

A narrow limestone valley, in which Chockolocko Creek flows, separates the Chockolocko Mountain from the fine ridge East of Jacksonville, which I have called the Ladiga Mountain. The Southern extremity of this Mountain is at Oxford, and the Northern on the Georgia line, where Loosahatchee Creek cuts through it. The junction of the talcose slates and limestones may be seen at the foot of the mountain, at MR. WILLIAM'S, on the White Plains and Chulifinnee road. Specimens of a fine brown hematite are scattered over the surface along the valley; and a little farther on, a fine bed of the same ore is crossed by the public road.

Descending the Chockolocko Mountain to the valley just mentioned, the Western edge of the silurian limestone is seen dipping under the metamorphic rocks. It is a magnesian limestone weathering roughly on the surface.

On the right bank of the stream, on the road to Oxford, a bold spring, called the Boiling Spring, issues from the limestone, and may be fairly classed with the great fountains at Huntsville and Tuscumbia. The valley is here wide enough, and as the soil consists of a rich loam, it is occupied by excellent plantations. The Aborigines seem also to have been aware of these favorable circumstances, for a mound and other remains show that this was once an extensive Indian settlement. The stratum of limestone along which tne creek flows, is, like the Macon limestone, a dolomite.

The following analyses present the composition of this rock:

1. *A specimen from the bridge below the Spring.*

(Composition in 100 parts.)

Carbonate of lime	55.17
Carbonate of magnesia	43.39
Peroxide of iron	.89
Silica	.45
	99.90

2. *Is from Mr. Low's Spring Branch.*

Carbonate of lime	51.48
Carbonate of magnesia	34.32
Carbonate protoxide of iron	3.05
Alumina	.47
Carbonaceous matter	trace.
Insoluble matter	10.55
	99.87

The magnesian limestones, whilst they stand unrivalled for the excellence of the mortar produced from the lime they afford, must be used with caution when applied to the soil in the caustic state. The lime must be completely air slaked before it is spread abroad on the land. This locality has the advantage of vicinity to the Railroad.

At the extremity of the Ladiga Mountain, where the Alabama and Tennessee Railroad crosses, Oxford is situated, and although, as yet, this village has no place on the State Map, it is destined to become one day a town of importance.

By the Railroad survey, Oxford is 620 feet above Selma, and the base of the mountain is 76 feet above the town.

The limestone of the valley rests upon immense beds of siliceous rock that may be examined on Snow's Creek, at the mill. The rock is here a compact smooth-grained chert, that breaks with a conchoidal fracture, but towards the summit of

the mountain it is less compact, and by the oxidation of the iron it becomes brown and arenaceous like ordinary sandstone.

(Fig. 19.)

Section at Snow's Mill.

a, Siliceous rocks of the mountain.
b, Limestone.
c, Creek.
d, Chockolocko Mountain.

About two and a half miles above Oxford, a fine bed of brown hematite occurs on the land of J. SPENCER, ESQ. It may be traced over a distance of several miles; at MR. SPENCER'S it is 12 to 15 feet thick, but varies much in this respect. It is found in Sections 7 and 8, Township 16, Range 8. It runs parallel with a bed of quartzose breccia, of remarkable structure. Where masses of the rock are above the surface, it presents the appearance of quartz rock cracked in such a manner as to allow the percolation of a solution of oxide of iron between the loose fragments.

On Sec. 5 of the same Township and range, on the land of Mrs. Tehusen, a fine bed of this ore crosses the Alexandria road; it is of excellent quality. The line of the Railroad passes the ore at Mr. Spencer's, and it cannot remain long unproductive. I found, also, at this locality specimens of oxide of manganese.

Brown Hematite of Oxford.—In an economic point of view, the ores of this place have a special interest, derived from their position, the abundance of fuel, and vicinity to water power.

They have, therefore, been examined with care, and specimens from different parts of the extensive stratum have been selected and analyzed.

1. This is a specimen from the bed opposite Mr. Spencer's house, and represents the compact part of the bed.

[Composition in 100 parts.]

Per-oxide of iron	85.72
Siliceous matter	1.78
Alumina	.09
Phosphoric acid	.12
Water	11.07
	98.78

Metallic iron, 60 per cent.

2. Represents the cellular portion of the same bed. It is principally made up of variously bent, thin plates.

(Composition in 100 parts.)

Per-oxide of iron	69.22
Sesqui-oxide manganese	.98
Siliceous matter	16.24
Phosphoric acid	.09
Water	13.21
	99.74

Metallic iron, 48.45 per cent.

3. This is from that portion of the bed exposed in the woods. It is compact and somewhat columnar in structure, with fibres radiating from the axes of the columns.

(Composition in 100 parts.)

Per-oxide of iron	84.37
Sesqui-oxide of manganese	Trace
Lime	.08
Alumina	1.24
Silica	.15
Phosphoric acid	.56
Water	12.78
	99.18

Metallic iron, 59.06 per cent.

4. This specimen is from a large mass, having a mammillary structure. It occurs with the preceding.

(Composition in 100 parts.)

Per-oxide of iron	84.32
Sesqui-oxide manganese	.41
Alumina	.89
Silica	1.19
Phosphoric acid	Trace
Water	13.36
	100.17

Metallic iron, 59.02 per cent.

5. From the upper end of the bed, where it approaches the bed of breccia; it is compact, and has white particles of chert mixed with it.

(Composition in 100 parts.)

Per-oxide of iron	72.18
Sesqui-oxide manganese	1.92
Siliceous matter	13.85
Alumina	.73
Phosphoric acid	Trace
Water	11.55
	100.23

Metallic iron, 50.53 per cent.

6. This specimen is from a bed which is crossed by the Alexandria road; it belongs to Mr. Johnson. It is porous, and, in part, composed of yellow ochre.

(Composition in 100 parts.)

Per-oxide of iron	65.65
Alumina	.92
Sesqui-oxide manganese	1.33
Phosphoric acid	.13
Water	9.30
Insoluble	22.37
	99.70

Metallic iron, 45.95 per cent.

This ore, and No. 2, although they contain less iron than the others, will in practice be preferred, because of the greater ease with which they work.

The vicinity of a bold stream, abundance of fuel, excellent building materials, and proximity to a Railroad, point to this locality as the site of one of the future great iron manufacturing establishments of the State.

Copper Explorations.—The sandstone is succeeded by a series of clay slates which extend to Mr. Maxwell's, a locality of great interest in the county, as it was supposed that indications of copper, and even copper itself, existed there. The hill in which the supposed mine was situated is composed of clay slate, with beds of cherty rock passing into brown jasper, which is quite cellular and porous, resembling burr-stone; this, because it appeared uncommon, attracted attention, and became a "surface indication" of the copper below. Several cross ditches were excavated, and when the course of the bed was ascertained, a drift of 100 feet was driven into the hill to cut the copper! I need not say with what success.

Porcelain Clay.—A few miles North of Jacksonville, a shaft was sunk in a recent formation, composed of the debris of black slate, and beds of white and mottled clay, although not the least chance existed here of finding any valuable metal. The white clay is a pure kaolin, or porcelain clay. Should this earth be found in quantity, it may one day be of some value. The following is its composition:

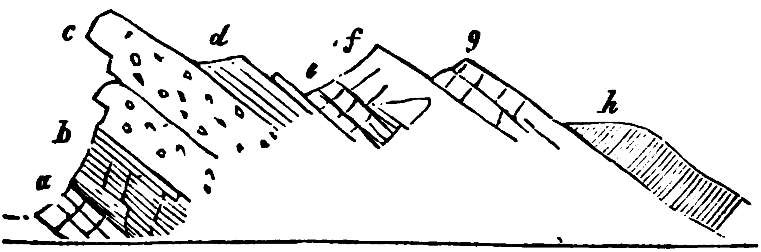
Combined silica	39.75
Free silica	4.85
Alumina	38.92
Per-oxide of iron	.78
Lime, Potash, &c	1.03
Water	13.38
Undecomposed mineral	.90
	99.61

The black bituminous slate is very abundant here, as it is reached in all the hills, and at Mr. Turner's it rises into a bold hill the base of which is washed by a little stream. In the hill East of Green's pit, a remarkable bed of breccia occurs, which has for its cement per-oxide of manganese, the mineral constituting the mass being angular fragments of white quartz.

There is also a bed of iron ore near Green's, but I have seen nothing else in the vicinity, besides the porcelain clay, which need receive much attention. On section 1, township 13, range 8, the land of Mr. Ethelred Griffith, specks of lead are found in the limestone on the side of the mountain, but no signs of a vein, or any circumstance that would justify much expenditure of money or labor. At Mr. J. C. Bairds', section 14, township 13, range 8, a bed of good brown hematite occurs, associated with a bed of chert.

Ball-Play Mountain.—This is really one of the most beautiful and picturesque localities in this part of the State. The mountain, however, only appears such when seen from the valley, which is part of that of the Coosa. The mountain presents, on top, an enormous escarpment of sandstone, composed of a stratum of sandstone 60 feet thick, looking towards Coosa. This is underlaid by soft limestone, which, as it wastes away, leaves the upper stratum fearfully impending over the valley below.

(Fig. 22.)



Section on Ball-Play Mountain.

a. Limestone.
b. Reddish limestone and sandstone.
c. Powerful bed of whito sandstone.
d. Red argillaceous limestone.
e. Cherty beds.
f. Limestone at Griffith's.
g. Chert and limestone.
h. Black Slate at Turre's.

This section is about two miles in length.

At the base of the mountain I found Mr. Cook at work in search of lead. Although the amount of lead absolutely seen amounted only to mere specks, yet the accompanying minerals were favorable. A thick bed of sulphate of barytes may be traced on the surface, whilst in the excavations made in the rock, calc-spar, blende, and fluor-spar were found—the only locality in the State where I have observed the latter mineral. The indications at this place were really promising; but it requires capital to sustain an undertaking like this, and as no regular lode was discovered, the proprietors very wisely desisted from further expensive explorations. Operations were conducted in the lower level—*a.* in the section.

The red sandstones (*b.*) are very good grit for the manufacture of grindstones.

The red argillaceous limestones (*d.*) occupy the surface immediately back of the escarpment, and give rise to one of those open spaces called "glades."

The mountain terminates at Hoke's Bluff, on the Coosa, above Gadsden.

Resuming the section upwards through Cherokee, at the bridge over Coosahatchie, or Terrapin Creek, limestones, variously intersected by veins of calc-spar, are found under and below the ledge, and, for a half mile beyond, they occupy the road as it passes through a cedar glade. At McElrath's mill a fine section of the magnesian limestone occurs. On the hill beyond there is a joint in the strata, and the rocks are seen dropping from the summit of the hill.

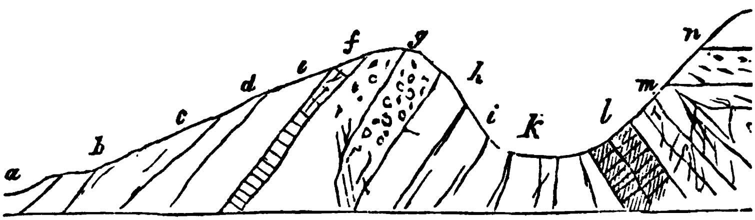
Cedar Bluff—Stands on the right bank of the Coosa, 28 miles below Rome, Ga. The bluff is 25 to 30 feet in height; it is composed of an argillaceous, shaly rock, with concretions of lime, and strata about one foot in thickness, curiously weathered on the surface, as if made up of irregular concretions of lime in the clay, the lime afterwards being washed out. At points in the bluff, the strata are seen with a South-East dip, then horizontal, and again much contorted. In the streets of the town, and for two miles beyond, the limestones are seen occupying the same place. Beds of cherty limestone succeed these, and, near the Chatooga, thick beds of limestone abounding in stems of encrinites. These strata underlie the Red Mountain Group, which enters the valley of the Chatooga on the West.

Two miles South of Centre, rounded, water-worn pebbles are seen on the surface. They are brown and ferruginous, and extend for a considerable distance around the town. Similar beds of drift occur above Turkey-Town on the left bank of the River.

At Gaylesville the underlying rock is a cherty shale, abound-

ing in encrinital remains. In the valley the shale is dark-colored, and sometimes black.

(FIG. 21.)



Section of the strata from Gaylesville, over the Mountain, to Spring Creek Valley.

a. Chatooga River.
b. Cherty rocks.
c. Slaty rocks with numerous corals.
d. Chert.
e. Sandstone, used for building materials.
f. Red iron ore.
g. Thick series of variously colored sandstones.
h. Cherty limestone.
i. Red and mottled sandstone.
k. Limestone of Spring Creek Valley.
l. Black slate.
m. Cherty rocks.
n. Coal measures of Lookout Mountain.

The red ore of this section is of excellent quality, and is exposed on the dip in a regular bed, a foot to eighteen inches in thickness. As this is but a mile and a half from the river, and the way all descending, with fuel in the greatest abundance, one could hardly desire more favorable circumstances for the manufacture of iron.

The yellow sandstone furnishes one of the finest materials for architecture.

Analysis of the Red Ore from Gaylesville.

(Composition in 100 parts.)

Per-oxide of iron	82.67
Sesqui-oxide of Manganese	.40
Silica	13.44
Alumina	3.09
Lime	Trace
Phosphoric acid	.06
	99.66

Metallic iron, 57.87 per cent.

SECTION FROM SPRING CREEK VALLEY, OVER THE MOUNTAIN, TO WILL'S VALLEY.

The section was continued over the Mountain without interruption.

The carboniferous limestone which succeeds the cherty beds associated with the black shale, shows but slightly at the foot of the mountain. A short distance below the road over the mountain, a cave of some interest is found in the rock. It is dry, extensive, and filled with beautiful stalactites.

This rock is succeeded by the usual thick beds of mill-stone grit, which constitute the mass of the mountain. Towards the top, a thin seam or two of coal occurs. On the left of the road, and a short distance from it, the lower falls of Little River occur. There are few phenomena more curious than these falls, amongst the coal measures. A stream is found, draining the flat surface generally found on the tops of these mountains, flowing over a slightly inclined, rocky bottom, but little excavated. On the banks of the stream no difference of level above and below the falls is found, when suddenly, without any notice, the water is precipitated over a perpendicular escarpment, as if the bed of the stream had sunk. The water flows gently along till it is abruptly precipitated over a perpendicular escarpment. Although the height is only 46 feet,

as the water flows down in one unbroken sheet it presents a picturesque view well worth a visit. The undermining of the rocks takes place in consequence of beds of shale that underlie the bed of the stream above the falls. So that, like all such falls, they are constantly receding.

About a mile below the falls I was sorry to find a party of intelligent men misled by an ignorant man, who made them believe that he had discovered a silver mine. The reputed mine is in the slate which overlies a seam of coal! The ore is nothing more or less than nodules of iron stone and sulphuret of iron, notwithstanding the fact that silver had been "run out of it." The bluff at this point is 150 feet high, and the seam of coal is found about 25 feet above the base.

After passing over the summit, the carboniferous limestone is seen in force towards the foot of the Mountain, on the Will's Valley side. This is everywhere the case; the carboniferous limestone is found in far greater force on the Western than on the Eastern side of the mountains.

The valley, though not wide, is highly fertile throughout nearly its entire length.

Near a meeting house, to the left of the road, and West of the tan-yard, a very strong sulphur spring occurs, in a pleasant little valley, that ought to be a pleasant place of resort.

The valley is divided by a ridge, which is crossed in a gap between Van Buren and Lebanon. This ridge belongs to the Red Mountain group, and has on its top a stratum of red iron ore.

The valley was examined to the Georgia line, but the details must be reserved for a future report.

The black slate which is exposed on the Western side of the valley excited, as elsewhere, some interest in relation to copper, and some useless labor was expended in the search.

Chapter Fourth.

Economic Materials—Red Ore of Columbiana, St. Clair and Hanby's—Brown Hematite of Bluff Creek—Riddle's Bloomery—Weir and Scott's Bloomeries—Ore from McClanahan's—Benton Iron Works—Oxide of Zinc—Ores from the Coal Measures—Concretions from Chambers—Copper Ores—Mines of Ducktown—Wood's Mine—Stringfellow's Mine—Table of Localities of Copper—Building Materials—Talladega Marbles—Soapstone—Flagstones—Roofing Slates—Lime Burning—Hydraulic Limestone—Louina Porcelain Clay—Plumbago, or Graphite.

I propose in the present chapter to offer some additional facts in relation to the economic materials derived from the rocks of the State, that have not been presented elsewhere.

ECONOMICAL MATERIALS DIRIVED FROM ORES AND ROCKS.

Iron Ores.—The principal iron ores of the State have been examined, and numerous deposits added to those already known. The red or fossiliferous ore is now known to extend almost without interruption from a point two miles and a half below Pratt's Ferry, in Bibb county, to the upper end of Will's Valley, DeKalb county; and on the East, in Cherokee, to the Northern part of the county. On the West it runs up to Murphy's Valley. The thickness is variable, being in some localities twenty to thirty feet, and in others thinning down to one foot.

North-East of Greenesboro', and on the North-West side of the Red Mountains, a bed occurs ten feet in thickness. South-East of Elyton the ore continues for a distance of three miles. It caps the mountain and is fifteen feet in thickness. About Trassville, beds of brown hematite occur, not far from the red

ore beds. On the spurs of Cedar Mountain, red ore is found. with numerous joints of crinoidal stems—hence the name button rock applied to the ore.

In St. Clair county, South-West of Springville, the ore occurs in a stratum fifteen feet thick, but varying in quality in different parts of the bed. At Pierson's Mill, in the same county, the ore is about seven feet thick. The ore is composed of large glazed grains; the composition is as follows:

(Composition in 100 parts.)

Per-oxide of iron	51.46
Silica	27.74
Carbonate of lime	19.89
Alumina	2.32
Oxide of manganese	.24
Phosphoric acid	.16
	99.81

Metallic iron, 36.02 per cent.

In Murphree's Valley the ore is found in a bed seven to eight feet in thickness. There is also a bed of brown hematite near this locality, one mile in length, composed of irregular masses.

At Hanby's, on Turkey Creek, there is a bed of this ore, which is a continuation of the Murphree's Valley ore. It is about twenty feet in thickness, and as it occurs on the side of the mill pond, it can be transported by water to the falls of the Creek, where an admirable site for a furnace may be found.

ORE FROM HANBY'S.

The ore is oolitic, with shining surfaces on the recent fracture. It is stratified.

(Composition in 100 parts.)

Per-oxide of iron	61.87
Silica	37.58
Alumina	.26
Lime	.03
Oxide Manganese	.05
Phosphoric acid	.03
	99.82

Metallic iron. 43.31 per cent.

Since this was written I have received a series of specimens from this locality, taken from an excavation in the bed. They show a great improvement in the ore, when compared with the specimen analyzed, which was taken from the surface. The results of their examination will appear in a future report.

I have not attempted to enumerate all the localities where this ore is found in quantity; it so happens that it belongs to one of the most persistent formations in the State, one which extends from the North-Eastern boundary of the State to Pratt's Ferry, on the Cahawba, and it seems only necessary to describe those beds most likely to come first into use.

The means of comparing this ore, both in quantity and composition, with similar ores from Pennsylvania and New York, will be found on page 31 of my first report.

BROWN HEMATITES.

In my first report I stated that it was probable that all the brown ores belonged to true beds, interstratified with the other rocks. A more extended observation has satisfied me that this is not the case with all the ores of this character in the State. The ores of Bluff Creek, North Alabama, and indeed all those in that part of the State, belong to the newer deposits, as may be seen from their admixture with the pebbles of the surface, and from their uncomformable position. This fact is not so easily observed in the great iron deposits of

Roup's Valley and Shelby, for here there are no pebbles, the ore being mixed with, and completely enveloped in, a red loam; and what makes this the more puzzling, these deposits follow, in direction, very nearly the strike of the rocks. In Roup's Valley, for example, the ore is found occupying a narrow belt, six to eight miles in length, having a course nearly North-East and South-West, almost co-incident with that of the underlying rocks. This is the case with the beds from which the bloomeries on Shoal Creek are supplied. The deposits on Shelby's Creek, as well as those in Talladega, are also disposed in a similar manner.

Brown Hematite, Bluff Creek, Limestone County.—The ore is compact, with irregular cavities, and has a fibrous structure.

(Composition in 100 parts.)

Per-oxide of iron	80.65
Sesqui-oxide of manganese	.26
Alumina	.09
Magnesia	Trace
Phosphoric acid	.92
Water	12.37
Insoluble matter	5.58
	99.87

Metallic iron, 56.45 per cent.

It will be seen from this analysis, that the ore on Bluff Creek compares favorably with the ores of the State of the same variety. And there is only this difference, that it will require greater care in the selection, for reasons already pointed out.

Riddle's Bloomery.—The ore used here is from Mr. SEAY's bed, already described. Mr. SEAY informed me that the cost of 3,000 lbs. of ore delivered at the works was $4 50. The distance was about six miles.

The following account of the works, furnished to Mr. LIEBER by Mr. RIDDLE, will show the cost of production at these works.

"The works of J. RIDDLE were commenced by J. M. MOORE, ESQ., in 1836. The Eagle Forge was erected by MESSRS. RERSEU and WILLIAMSON in 1846, and is now owned by G. M. RIDDLE and WHILEY SAUNDERS. Rob Roy was built by JOHN MOORE and G. M. RIDDLE in 1852, and is now offered for sale. A little forge, not now in operation, was built by SILAS GARREGUS, near Chinebee, on Horse Creek.

In these forges there are four stamps of 50 lbs. each. There are two furnaces at each forge, and in ordinary years the Talladega Creek will drive the blast for nine months. It requires fourteen to fifteen hands to attend to a forge. The working force is divided thus:

One (sometimes two) hammerman.	Working at forge.
Two firemen..........................	
One hand to stamp and roast ore.	
Four hands to chop wood.	
Three teamsters.	
Two colliers.	

"The cost of putting up such works, exclusive of dwelling houses, roads &c.. is from $2,500 to $3,000.

"The charge of the furnace is usually 5 lbs. of ore to 1 lb. of iron. The charcoal used is 700 bushels to the ton (of 2,000 lbs.) of bar iron. The weight of the loup of iron produced, varies from 100 to 135 lbs., and is made in three hours, so that four loups are the result of a full day's work. A loup of 125 lbs. yields 100 lbs. of bar iron. This is worth $5 50 per 100 lbs at the works. The pound of iron ought not to cost the manufacturers more than three cents.

"All the ore is now obtained from the Chinebee bed, at SEAY'S, 25 cents being paid for the priviledge of hauling a load of 3,500 lbs. of ore. For raising the ore and piling it at the bank 25 cents are given, while the hauling amounts to $1 per 1,000 lbs. The Chinebee bed has now been worked thirteen r fourteen years."

Small irregular pieces of iron are formed during the working of the loup, which are found troublesome. On being dissolved in sulphuric acid, they give a considerable amount of phosphorus and quartz, chemically combined. It is probable, therefore, that these are portions of the iron, rendered hard by such impurities.

Weir & Scott's Bloomeries.—Shoal Creek, Shelby County, furnishes some fair sites, and abundant power for iron works of far greater extent than those at present situated on it. The ore is found on the side of the ridge which runs parallel with the Montevallo road, and is raised at $1 per ton. As the Creek runs along the verge of the Cahawba coal field, it cannot be a long time before the bloomeries will give place to high furnaces, where coke, instead of the more expensive charcoal, will be used as fuel.

To show the enormous waste in this the primitive mode of manufacturing iron. a portion of what appeared to be richest of the slag, but which was by no means a small part of the heap, was analyzed and gave 44.80 per cent. of iron. In the high furnace it is evident that this slag will all be worked over with profit.

McClanahan's Furnace.—The beds at this place have been re-examined. The ore is enclosed, in the manner just stated, in a bed of red loam which extends towards the Coosa, two or three miles from the furnace. In the open pit, in which the fine fibrous variety is found, the fragments are angular, and the fractured surfaces quite sharp, being barely soiled by the loam. That they were fractured since their deposition is quite evident, and that they were not afterwards transported is equally so; for there is not the slightest evidence of water-wearing, even on the sharpest angles of the fibrous fragments. The impression left by an examination of this locality, is that the whole was thoroughly shaken up, but not transported.

Fibrous Brown Hematite from McClanahan's Furnace; a part of the Bed not already examined.—The specimen is from a bed near the furnace. It is of a structure distinctly fibrous and radiating.

(Composition in 100 parts.)

Per-oxide of iron	82.82
Sesqui-oxide of manganese	.77
Lime	Trace
Alumina	.35
Silica	.29
Phosphoric acid	.15
Water	14.62
	99.00

Metallic iron. 57.97 per cent.

Benton Iron Works.—Some difference seemed to exist between the ores from the two beds explored at this place; the upper one being preferred, whilst in the reduction of the ore from the lower bed, or one nearest the furnace, some difficulty seemed to exist. Specimens from both beds were examined with the view of throwing some light on the matter.

1. Specimen from the upper bed, porous, and containing much yellow ochre in the cavities.

(Composition in 100 parts.)

Per-oxide of iron	76.84
Sesqui-oxide of manganese	.37
Alumina	2.34
Magnesia	Trace
Phosphoric acid	1.08
Water	13.76
Insoluble matter	5.17
	99.56

Metallic iron, 53.79 per cent.

The considerable amount of phosphorus in this ore no doubt gives it the property of producing the sharp castings for which the hollow ware of this establishment is noted.

2. A more compact variety than the preceding, with minute specks of ochre in the pores.

(Composition in 100 parts.)

Per-oxide of iron	82.45
Sesqui-oxide of manganese	.63
Alumina	.77
Lime	Trace
Magnesia	Trace
Phosphoric acid	Trace
Water	12.70
Insol. matter, with a little alumina	3.21
	99.76

Metallic iron, 57.71 per cent.

The preceding are from the upper bed.

1. From the bed near the furnace. Partly compact, and composed of layers, with siliceous particles derived from decomposed chert embedded in the mass.

(Composition in 100 parts.)

Per-oxide of iron	68.13
Alumina	.46
Sesqui-oxide of manganese	46
Phosphoric acid	.02
Water	10.89
Insoluble matter	20.02
	99.98

Metallic iron, 47.69 per cent.

2. From the same bed—more compact than the preceding, with iridescent tarnish on the surface, and having embedded particles of chert in a chalky state.

(Composition in 100 parts.)

Per-oxide of iron	73.64
Sesqui-oxide of manganese	.13
Copper	Trace
Alumina	1.41
Phosphoric acid	Trace
Water	9.77
Insol	15.49
	100.44

Metallic iron, 51.55 per cent.

It is difficult to point out any difference in the composition of the ores of these beds, that could interfere with their reduction, unless it be the greater amount of insoluble matter in the beds near the furnace. And this can be detected by the naked eye, for the fragments of siliceous minerals embedded in the ore are often large, and such portions should be rejected. The greater richness of the upper beds will doubtless compensate for the additional expense of hauling.

As it is probable that these ores are derived from sulphurets, the *trace* of copper found here is not surprising, nor is it very uncommon in the brown ore of the State.

Oxide of Zinc.—Masses of this mineral of several pounds weight are, from time to time, taken from the crevices in the stack; as no traces of zinc have been discovered in the ore, it is almost certain that it had been introduced into the furnace with the limestone used as flux. Sulphuret of lead is known to exist in the limestone at this locality, and zinc blende, being associated with it, is conveyed to the furnace with the limestone in which it is found.

The mineral is of olive color, waxey lustro, and is disposed in concentric layers.

(Composition in 100 parts.)

Oxide of zinc	97.77
Prot-oxide of iron	1.21
Oxide of manganese	Trace
Silica	.64
Carbon	.08
	99.70

The following is from Chambers County. It is found in deposits of some extent, wherever hornblende rocks are undergoing disintegration. It resembles bog-ore, but contains scarcely iron enough to be admitted as an ore of that metal. It was looked upon with a great deal of interest during the period of the copper exploration, and for that reason it is introduced here. It seems to be made up of concretionary nodules, with shining points on the fresh fracture.

(Composition in 100 parts.)

Per-oxide of iron	28.76
Sesqui-oxide of manganese	2.57
Alumina	1.12
Lime and magnesia	Traces
Phosphoric acid	.08
Water	6.12
Insoluble matter	60.94
	99.59

ORES FROM THE COAL MEASURES.

We need not expect to know much of these ores, till the Warrior coal field is explored to a much greater extent. No mining, worthy of the name, has yet been done, and as the ore occurs in the overlying shale, it is but rarely that it can be detected on the surface. There are, however, some promising localities in Jefferson and Walker Counties, as will be seen from the following analyses.

Iron Ore from Jefferson County.—A compact, dark colored ore, containing vegetable impressions.

(Composition in 100 parts.)

Carbonate prot-oxide of iron	86.85
Carbonate prot-oxide of manganese	3.04
Carbonate of lime	2.12
Carbonate of magnesia	.12
Per-oxide of iron	.43
Alumina	.06
Water	1.17
Carbonaceous matter	Trace
Insoluble ingredients	6.37
	100.16

Metallic iron 42.23 per cent.

Specimen from Walker County.—Compact, blueish-grey on fresh fracture, yellow on outside, and exfoliating in concentric layers.

(**Composition in 100 parts.**)

Carbonate prot-oxide of iron	70.84
Carbonate prot-oxide of manganese	1.53
Carbonate of Lime	2.31
Carbonate of magnesia	7.64
Per-oxide of iron	1.20
Alumina	.13
Water	.84
Insolluble matter	14.94
	99.43

Metallic iron 35.04 per cent.

COPPER ORES.

The excitement on the subject of copper which prevailed over the North-Eastern Counties of the State, deserves perhaps a passing notice. The mistakes committed, arose, for the most part, from hasty generalizations upon surface indications. The notion is quite prevalent that the presence, below the surface, of every ore is indicated by certain invariable signs, which may be observed on the surface of the soil, containing the ore. That certain rocks and minerals are often associated with the various metallic ores is quite true. For instance, gold, as a general rule, is found in talcose rocks, and the gangue with which it is associated is, for the most part, quartz; and although it would not be unreasonable to look for gold in talcose slates, and in quartz veins, yet it would be a great mistake to expect to find gold in all quartz veins found in talcose rocks. The practiced eye can perceive differences in the quartz, as well as in the slates, that escape the ordinary observer unnoticed. So, also, calc-spar. sulphate of barytes, and fluor-spar, in some regions, are found associated with lead, but lead is not invariably found wherever these minerals occur.

In different countries, too, different ores present different groups of associated minerals.

In Missouri, the copper veins often terminate at the surface in that variety of iron, called specular-oxide; whilst, at the famous mines in Tennessee, the copper is indicated by a soft and porous mass, composed of a mixture of red and brown oxide of iron, which occupies the upper portion of the veins, or that part seen at the surface, and is called by the Cornish miners "gossan." The difficulty, then, of giving any general rules for determining the presence of metals will be at once apparent. Their existence and peculiar association determined for a district, this knowledge may be applied with a chance of success where similar circumstances exist.

The range of formations in which the various metals may occur is also pretty well established, and this fact furnishes, to a certain extent, a reliable guide.

As the Tennessee mines were the grand type to which everything relating to copper in Alabama was referred, it may be instructive to present a concise view of those remarkable mines.

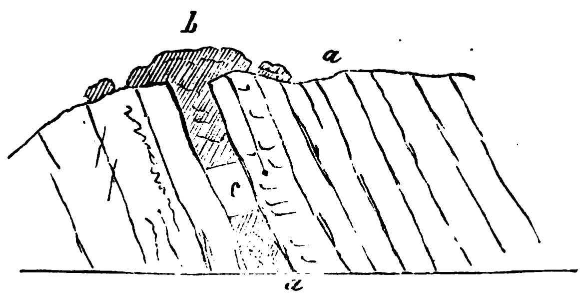
On the Ocoee river. near the corner of North Carolina, and amongst the mountains, there is a district of a few square miles, in Polk County, in which the mines are situated. The ore is found in beds apparently contemporaneous with the slates in which they are enclosed. The slates are, for the most part, talcose, and sometimes chloritic. The hanging wall of the beds is generally a thick-bedded stratum of rock, in structure somewhat gneissoid, and sometimes resembling whitestone.

On the surface may be seen coarse rusty masses of impure iron, much intermixed with siliceous sand, and having a general direction of North-East and South-West. These masses are the out-cropping edges of the copper bearing beds, or veins as they are called. Their thickness is very great, often amounting to twenty-five or fifty feet.

If a pit be sunk on these beds to a depth below the surface

varying from a few yards to several fathoms, the "gossan" will be found to terminate suddenly in a black heavy substance, which is the copper ore. When the excavations are extended downwards through the ore, another mineral is reached, differing very essentially from it; this is iron pyrites, the "mundic" of the miners. This lower portion of the vein besides the mundic contains crystalline quartz and two per cent. of copper ore; what is below this mundic is a problem of great interest, not yet solved. A diagram will represent the state of the Ducktown mines better than many words.

(Fig. 22.)



Mine at Ducktown.

a. The gossan.
b. The ore.
c. The underlying part of the mine, made up of mundic, quartz, and a little copper ore, in the form of yellow sulphuret.

In order to understand the changes that have taken place in these mines, let us suppose, what was certainly once the case, that that portion of the vein now occupied by the gossan and ore was filled with yellow sulphuret of copper and impurities. During the changes to which this region has been subjected, the yellow ore was converted into the black mass at present occupying a part of the vein. This black ore is more

or less subject to spontaneous decomposition, by which is is rendered soluble, and the copper is dissolved out by every shower of rain by the simple process of leaching. In this way every atom of copper is often dissolved out from the black mass, leaving behind nothing but the impurities. silica, alumina, and oxide of iron, in the form of gossan. This process is going on at the present time in the mines, as is proved by the copper held in solution by the water percolating through the works. And in this way every trace of copper is removed from portions of the beds. This is the simple explanation of the form and relative position of the gossan and ore at the Ducktown mines.

The ore is excavated with ease, and after being dressed, so as to bring the whole to as high a percentage as possible, it is boxed for transportation. From a table of sales from 1853 to 1854, of twelve lots, the average of pure copper was 20 per cent., and the average price for which the lots sold at the Northern smelting houses was $92.50 per ton. Out of this there is paid tor transportation $21.25 per ton, besides the cost of mining, and interest on capital invested.

That the discovery of mines so rich and so important, should have excited much interest, was quite natural, especially when coupled with the enormous prices paid for them when they changed owners; for very soon the price had no relation to the intrinsic value of the mine, as the whole was converted into fancy stock.

Visitors to Ducktown, seeing how very simple the relation was, that seemed to exist between the rich ore below and the iron-ore-like substance on the surface, returned full of the recollection of having seen a similar substance elsewhere. This was the simple origin of the very great interest that was felt in the discovery of copper. Everywhere that a substance was found that had any resemblance to the gossan of Ducktown, it was received immediately as an indication of copper. That a hasty generalization of this kind should lead to nume-

rous mistakes, can readily be imagined. As is usual in such cases the differences were altogether disregarded; the mere resemblance in the gossan seemed to be alone worthy of any consideration.

Now, copper ore is not the only substance that may have gossan in the upper portion of the vein or bed. Any rock containing a large amount of sulphuret of iron, by oxidation produces a gossan that cannot be distinguished from that resulting from copper. Near Oak-Bowery there occurs, on the surface, a porous oxide of iron precisely similar to the Ducktown gossan, which, at a depth of forty feet, terminates in a very porous, siliceous rock, abounding in iron pyrites. The whole process may be seen here; the sulphur, combining with oxygen, produces sulphuric acid, which unites with a portion of the iron and forms sulphate of iron, which is soluble, and disappears by leaching. The rest of the iron remains as an oxide, mixed with the porous rock that is seen on the surface, and extending downwards till it gets beyond the influence of atmospheric action.

Some excellent beds of iron ore, in South Carolina, have been formed by the oxidation of iron pyrites; and I have no doubt that many of our ore beds have had a like origin.

Arsenical iron is also subject to a similar change, and leaves behind an identical product.

Changes such as these are of frequent occurrence in metallic lodes. In veins of galena, carbonate, sulphate, and phosphate of lead are found occupying the upper portion. A knowledge ot these facts will at least tend to moderate the expectation of finding copper wherever a porous oxide of iron occurs. Besides, even if the gossan were really derived from copper ore, every particle of copper may have been dissolved out, and nothing left but the insoluble impurities which constitute the gossan—a circumstance not at all uncommon.

In carrying out the Ducktown analogies, several other circumstances of almost equal importance have been entirely

overlooked. The Tennessee copper lodes are really beds, and, as I have already stated, are cotemporaneous with the rocks in which they are found. The distinction between a bed and a vein is not always borne in mind. *Beds* lie between, and *veins* intersect the strata. Of course, I do not mean to say that copper should not be looked for in veins; I only mean to show how the most serious mistakes were committed, by utter thoughtlessness on the part of those who took up the search for copper.

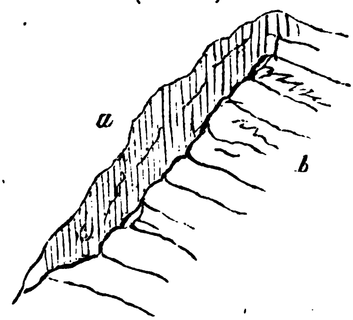
Many of the excavations in search of copper, that I observed, were made upon veins of the least promising character, notwithstanding that there was found on the surface great accumulations of gossan. Some of the veins explored at Chulifinnee, consist of fissures filled with angular fragments of slate, cemented with iron, that undoubtedly found its way in from the surface, in a state of solution. The size of these veins bears no proportion to the masses of vein-stone and gossan spread over the surface. For, as they resist the wasting action of atmospheric agencies, they remain, whilst the adjoining rocks of the country, being more destructible, are constantly disappearing by denudation, and in time a small vein gives rise to very considerable surface indications.

In the northern part of Randolph County, some very porous and light masses of impure oxide of iron occur, which have led to serious mistakes. The rocks at this locality are filled with iron pyrites from which the oxide results as already explained. This is found trickling down the surface and over the edges of the strata, filling any cracks or fissures that may occur in the rocks, and often forming deposits of three or four feet in thickness. At first sight, this might very readily be taken for a vein which has been exposed by denudation. But its porous character, and the fact that it contains embedded fragments of rock, as well as stems of plants, soon corrects the impression. The process of the formation of this ferruginous tufa may be seen in the ravines in the vicinity. Such

deposits are often found in the vicinity of chalybeate springs, but I have rarely seen anything precisely similar to this. The mass is a mixture of red and brown oxides of iron, with angular fragments of slate, and other impurities, and might very easily be mistaken for gossan.

The annexed cut will make the relations of this deposit plain.

(FIG. 23.)



a. Ferruginous deposit, which has flowed down the surface.

b. Outcropping edges of the rocks, containing iron pyrites.

A few miles from this, another locality occurs, which like the preceding has been explored to a sufficient extent to show the true character and nature of the deposit.

The slightest consideration of what has been said of the relation between copper ore and gossan, will show how fruitless must be the labor expended here in search of copper.

Another fact which seems to be almost entirely lost sight of, is the geological position of the metalliferous rocks of Tennessee, which are found in the metamorphic rocks, at the junction of two systems, and elevated 2,000 feet above tide level. As a general rule, the more disturbed the region, the greater the prospect of finding metallic lodes. Now, in Alabama, the line of junction of the two systems, the silurian and metamorphic, occurs along the mountain range, at the base of

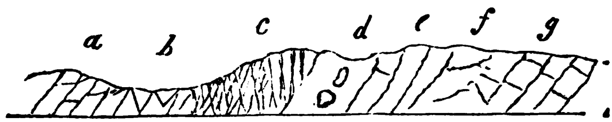
which the Chockolocko river flows; and it is worthy of notice, that it is along this line that nearly all the copper yet found in the State occurs. The rocks are highly inclined, and in nearly all respects identical with copper-bearing rocks of Tennessee. Overlooking these facts land, has been purchased, and leased, wherever any ferruginous matter could be found, without regard to these conditions, as the excavations in Benton, and elsewhere amongst the silurian rocks, show.

On Terrapin Creek, an adit of thirty fathoms in depth was driven in a hill side because of a porous, siliceous rock which is found on the surface; and North of Jacksonville, a shaft was sunk in a mottled clay which contained segregated masses of iron. At this latter locality, the bed penetrated is one of those superficial deposits that have resulted from the destruction of other rocks.

The mistakes of this sort that have been committed would fill a volume, and I mention these, not to repress reasonable expectations and judicious searches for useful materials, but to prevent extravagance, and the disappointment that must inevitably follow where men rush blindly into enterprises of which they have no knowledge. The first copper that I observed was in a mine, the property of R. T. Wood & Co. The ore is in the form of yellow and purple pyrites, and occasionally in that of a carbonate. The metal, however, is not found in a lode, but disseminated through a bed of grey, tough, talcose slates, twenty feet in thickness. The group of rocks with which it is associated is quite interesting. The strike is nearly East and West, and, although the slates are a good deal contorted, the general dip is about 35°.

The group presents the following order, beginning on the West:

(Fig. 24.)



a. Mica slate, filled with garnets, and presenting on the weathered surface rough, warty protuberances. The stratum is seventy feet thick.

b. Hornblende slate, containing a little copper.

c. A bed of quartz, 15 feet thick.

d. A dark colored mica slate, approaching to gneiss, six feet.

e. Copper-bearing slate, twenty feet thick.

f. Talcose rock.

g. Hornblende slate.

Copper was first discovered in a little stream that crosses the upper edges of the rocks; it was found in the form of a sulphate produced by the oxidation of the sulphuret.

Near this spot a pit was sunk and the ore found very uniformly scattered through the rock, A seam of oxide of iron, five or six inches in thickness, was cut, and gave fair promise of terminating below in copper; but, unfortunately, the rapid accumulation of water stopped further progress. Another pit was opened on more elevated ground, and so as to strike the bed a few fathoms below the surface. The results here were very much the same as those of the first pit; the ore was found under similar circumstances, but as no whim, or other contrivance, was erected, for clearing the shaft of water, of course further progress was soon arrested, and this second attempt, for the present at least, was abandoned. The truth is, although no one could display more untiring energy than did Mr. Wood, no mining project can be even commenced without a considerable outlay of capital. The mere preliminary operation of sinking a shaft is a very expensive one; yet, in general, it must be incurred even before the value of the mine is fairly

determined. Although no true lode was found at this place, it still appeared to me that the indications were sufficient to warrant a careful exploration at some expense.

Another most interesting locality is found in Hillabee, which presents the phenomenon observed at Ducktown more nearly than any other that I have seen. A few miles from the old Indian village of Candutchkee, in the Hillabee, a bed of gossan, three or four feet in thickness, was discovered on the crest of one of the little eminences so common in this region. A shaft was sunk in a position to cut the lode eight or ten fathoms below the surface. This was done with considerable difficulty, for below the surface the rocks were found to be very hard. The lode was so different in appearance from that presented by it on the surface, that it was cut through in the shaft, which was sunk ten fathoms. The lode, where it was struck, consisted of iron pyrites, with a little copper in the form of yellow sulphuret, and occasionally the surface of the vein was covered by sulphate of copper, and it therefore bore a strong analogy with that part of the lode at the Tennessee mines, below the black ore. The problem now to be determined, was the absence or presence of black copper between the gossan above and the iron pyrites below; and this was accordingly proposed to the superintendent, but the work was suspended at this interesting point, and nothing further could be learned.

If even traces of the black copper be found here, there will be great hope of finding it elsewhere; for the lode is found outcropping at localities equally, if not more, favorable. If, on the other hand, the Tennessee mines should terminate, as it is hoped, in yellow copper ore, then may we also hope to find this same ore below the mundic of the Hillabee mines.

I recommended the superintendent to seek for the black ore between the gossan and the pyritiferous portion of the bed. Mr. Lieber informs me that this was done, "and a thin seam of black ore, containing only a small per centage of eopper,

was found by MR. REID. The engine shaft was then sunk, to strike the lode at a greater depth, and solve the great Ducktown problem. At present, the copper, a fine yellow sulphuret, is intimately, but mechanically, mixed with a large excess of iron pyrites. Solid pieces, the size of hazel nuts, are sometimes, though rarely, found."

Operations have been suspended, on account, it is said, of some difficulty about the title, before any satisfactory result could be obtained.

The following concise table, prepared by Mr. LIEBER, will give a correct view of the mode of occurrence and localities of copper in the State.

CHARACTER OF ORE, OR CUPRIFEROUS MINERAL	Gangue, or matrix.	LOCALITIES.
Copper pyrites	Quartz between talcose slates.	Rob Roy iron works, Hillabee, Talladega Co.
Copper pyrites	Gneiss	Dr. Ulrich's, Tallapoosa Co.
Copper pyrites	Dioritic slate	Regan's, Hillabee.
Copper pyrites	Quartz in talcose slates.	McLee's, Hillabee.
Copper pyrites	Hornblende slate.	Lanier's, Tallapoosa Co.
Copper pyrites	Bed of iron pyrites with gossan at top	Stringfellow's, Hillabee.
Copper pyrites	Quartz veins	Dr. Ulrich's, Tallapoosa Co.
Copper pyrites	Hornstone	Long's, Hillabee.
Black ore	Between gossan and lower portion of bed	Stringfellow's, Hillabee
Cupriferous markasite.	Quarzose bed	Coosa.
Sulphate of copper	Quarzose bed	Stringfellow's, Hillabee
Sulphate of copper	Quartz bed	McLee's, Hillabee.
Sulphate of copper	Quartz bed	Clarke's, Coosa County.
Sulphate of copper	Hornblende bed	Wood's, Randolph Co.
Malachite	Quartz veins	Dr. Ulrich's, Tallapoosa County.

"The copper found in the segregative quartz beds, between talcose slates, at Rob Roy works, McLee's, and in Coosa, was only in small quantity, and mixed with iron pyrites. In the dioritic slate of Hillabee, at Regan's, it was present in very small quantity, only filling up minute crevices. The same may be said of its occurrence in the hornblende slate at Lanier's, Tallapoosa County. At DR. ULRICH's, we find it in solid but small bodies, mixed with iron pyrites, arsenical pyrites, and quartz veins. In the gneiss minute particles only exist."

DR. ULRICH's mine is situated in Tallapoosa County, section 8, township 23, range 22 East. A series of veins, near the junction of gneiss with talcose slates, has been explored to the

depth of eighteen feet, when copper was found in the quartz of the veins. The associated minerals are iron pyrites, of a yellow bronze color and iridescent, with white iron pyrites—heavy spar and fluor-spar also occur; but white quartz forms the main body of the vein. The copper is mostly found at the intersection of the veins. These veins have also been cut in a cellar, dug for other purposes: the thickest vein is from eleven to thirteen inches, and the smallest one from one to four inches. It is highly interesting to find a mine showing copper in regular veins, and as "Dr. Ulrich proposes to engage in further developement of his mines, by systematic operations, there is much reason to hope that he will thus be able to settle in the most satisfactory manner, whether or not copper veins exist in the State," so that all speculations as to the future prospects of the mine would be perhaps premature.

BUILDING MATERIALS.

In addition to those enumerated in my last report, I have now to direct attention to the very beautiful granite of Coosa, Tallapoosa, and Chambers Counties.

As a building material, the granite of Socapatoy is little inferior in beauty to marble. It should, however, be opened below the surface, as that portion is often discolored. It may be split with ease in any direction, and blocks of any required size may be produced at almost any of the localities along the strike of the rocks. The nearest point to the Coosa, where it is found on the surface, is Corn Creek, above Wetumpka.

The coarse rock at Wetumpka, though not a handsome building material, possesses great strength, and will answer well for lintels of doors, &c., and admirably for curbstones for pavements.

The granite at Milltown, from the peculiar manner in which it breaks up into layers, and from the joints which intersect it, might be split up into fence posts, that would require no

dressing. The vast masses that occur at Rockford, Coosa County, would supply any demand, at the lowest possible cost for quarrying.

The very beautiful gneiss with black mica, of Chanahatchee, in Coosa, would also furnish a building stone of striking appearance.

Marbles.—In my last report, I gave a brief account of the marble at DR. SAUTT'S, in Talladega. This quarry is still in operation, and judging from the slabs recently brought to market, it must be in an improved condition. The disagreeable stripes of talcose matter, that so deformed the first marble from Talladega, seem to be now avoided. The following is a notice by MR. LIEBER, of the quarries of Talladega marble, that did not appear in my former report.

"The geological position of this marble, as far as we may judge from the position of the quarries, places it as the marginal band of the limestone, where this approaches to metamorphic rocks. The member of this group which rests directly upon the marble is the talcose slate, with the single exception of MR. HERD'S northern quarry, where a bed of sandstone, and one of quartz rock, are interposed between them. From this it would seem probable that the metamorphic action, which contorted the slates to their present position, also exercised some influence upon the limestone. To GEORGE HERD, Esq., lately deceased, is due the credit of having been the first to draw attention to the marble of Talladega. This took place at as early a date in the history of that portion of the State as the year 1836, even before the Indians were driven out. From that period to his death, (in June, 1855,) his industry and thorough acquaintance with his business, enabled him to amass a fortune, and to benefit his fellow citizens to such an extent, that probably few men have the good fortune to leave as many friends and as few enemies behind them. He had placed his works at what afterwards proved to be a very inferior quarry, and, had he lived longer, intended

to have removed them to his northern quarry, which project his brothers are now carrying into effect. The firm is now ALEX. HERD & BROTHERS and the character of their splendid quarry, together with their knowledge of all that pertains to the business, dispel all doubts as to the increased success of the enterprise. MR. HERD leading the van, others followed. These were DR. EDW. GANTT, MR. J. M. N. B. NIX, MR. TAYLOR, and DR. MCKENZIE. Besides the quarries of these gentlemen, there are other localities where, at some future day, we may expect to see operations commenced. Thus, at the plantation of GEO. C. PLAYER, ESQR., marble exists, and, since it underlies that of MR. NIY, we have every reason to hope that its quality is good. Nor should I omit to mention the black marble atCol. GEO. HILL'S, which, though too siliceous above, may prove valuable beneath.

"The smoother the marble is at the surface the better it is, the irregularities being caused by interstratifications of cherty and talcose matter. As a general rule, the marble improves in depth. The difference in the character of the various marbles of Talladega is very considerable, both as regards their compactness, color, and the thickness of the beds. Thus, the difference in the compactness between the marble from MESSRS. HERDS' upper quarry, and that from the one of MR. NIX, is seen both by the amount of drilling which each hand can perform, in a day, as shown in the table to be found in the chapter on "Mines and Mining," in this report, as well as by the fact that at MESSRS. HERDS' quarry the drill holes have to be made at the rate of 3½ to 4 in a foot, while at MR. NIX'S there are about four or five in a foot. At the latter place they have to drill to within three inches of the point to which they desire the block to break off even, at the former often only to within six inches. This saves a large amount of labor. The different colors may be seen in the following view:

Herds' northern quarry—Brilliant white with occasional cloudings, like Italian marble.

Nix's quarry—White and blue, chiefly striped.
Gantt's—Opaque with talcose matter.
Taylor's quarry—Chiefly blue, some white.
McKenzie's quarry—Chiefly blue, some white.

MARBLE FROM HERD'S QUARRY.

The remarkable brilliancy of Messrs. Herds' marble is very peculiar, and perhaps unexampled among all stratified marbles. It is quite free from that dead, plaster-of-paris white, which is otherwise so common, while delicate blue cloudings relieve the else universal white, in a manner which I had hitherto regarded as a distinguishing beauty of the statuary marble from the famed quarries of Carrara. These darker spots are caused, probably, by the presence of a minute portion of carbonaceous matter, and should by no means be mistaken for the talcose stripes of other marbles, which give them the appearance of being soiled or weather-stained.

With regard to the thickness of the marble beds, a great difference is perceptible. Thus, at Dr. Gantt's quarry, the size rarely exceeds two feet. The same may be said of all the other quarries with the exception of that of Messrs. Herd, where the upper bed measures eight feet three inches in thickness, and how far it originally extended above this it is impossible to say. When I examined the quarry, on the 19th of April, 1855, they had not yet reached the bottom of the second bed, which must be materially heavier, as they had already sunk fifteen feet below the talcose beds. Fissures are occasionally met with, locally termed "dries" or "cutters," which will decrease in number lower down, and even at present have not interfered with the work.

"At the time when my observations were made, I roughly estimated the amount of marble taken out at 3000 cubic feet, Mr. Geo. Herd having occasionally removed blocks from this quarry also. It is situated on a hill-side, probably sixty feet above the creek, so that no water need be feared, the presence

of which so greatly augments the labor at Dr. Gantt's place. As I had expected, when visiting it several months previous, the good quality of the rock greatly increases with depth. This marble shows but little, if any, difference in the manner in which it works on the bed or on the edge; while it is at least five times more difficult to drill Mr. Nix's rock on the edge than it is on the bed. This similarity of hardness in the two directions, although not sufficiently great to adapt it for statuary purposes—for which unstratified marble only can be used—will make it preferable for heavy work, such as architectural applications, obelisks, &c. The thickness of the beds may, however, render the converting it into slabs more expensive than with other marbles.

"In sawing and dressing, one-half inch is lost for each slab, except the outside ones, where the loss is an inch. Thus, in sawing up a block two feet thick into two inch slabs, we have $\frac{24-2}{2\frac{1}{2}}=9$. The average size of the blocks quarried is 2.4 ft.x3 ft.x6.5 ft.=78.6 cubic feet; which, at the established value of $2 per square foot, will return $324. The common size of the slabs is 6x3 ft., 4x2 in. They calculate 160 lbs. to a cubic foot, but 200 lbs. would probably be more correct. The Herds sell no raw material.

"When their thirty horse power engine is at work and the Railroad finished to the hundred mile station, (five miles from their quarry) their business can scarcely prove insignificant. The quarry is West of one of the highest peaks of the Rebecca mountains.

Analysis showing the composition of this pure and beautiful marble:

(Composition in 100 parts.)

Carbonate of lime	99.47
Carbonate of magnesia	.38
Silicia	Trace
	99.85

It is, therefore, a pure carbonate of lime.

"The quarry of J. M. N. B. NIX, Esq., is in range 4, East, township 20, South half of section 36, one mile and a half East of the plank road, and nine miles from the hundred mile station of the Railroad."

It has already been remarked that this marble works five times more easily on the bed than on the edge ; that is to say, a hand will, in a day, finish readily ten feet on the former and only two on the latter ;—hence, the edge-work is generally left to the saws. The cost of the-bed work is twenty-five cents per foot. Drilling is paid at the rate of seventy-five cents per hundred inches. One hundred and fifty are given as a day's task to the black hands, but two hundred are easily accomplished. White hands engaged receive two hundred dollars per year. The quarry was opened in 1850, and the amount of marble taken out shows that Mr. Nix must have prosecuted the work with great industry and energy. A large engine (besides a small one for lumber) has been connected with the works, and, during favorable seasons, the water power in the Emaukee nearly equals the power of the engine.

The general prices for the Talladega marble are, at the quarry:

Rough, per cubic foot..................................	$ 2.00
Plain dressed, "	10.00
Roughly sawed, per square ft. 2 in. slabs......	0.75
Dressed in 2 in. slabs, per square foot..........	2.00

Mr. Nix furnished me with the following approximative statistics of his works:

	1850	1851	1852	1853	1854
Amount quarried, in tons.............	100	150	150	300	400
Hands employed in quarrying........	20	20	10	20	20
Hands employed in dressing, in Selma, Montgomery, and on spot......	12	12	12	21	21

During the first two years the quarrying hands were much employed in chipping. He hopes to have in all a hundred

hands at work when the Railroad is finished up to the hundred mile station.

The variegated marbles of our State must remain undeveloped until cheaper means of transportation be introduced.

A very elegant marble occurs above Ashville. It is grey, with bright yellow and greenish veins. It occurs in thin beds in a ridge cut in two by Canoe Creek, not far from where the road to Greensport diverges from the Ashville road.

The drab-colored limestone of North Alabama will furnish a handsome marble.

SOAP STONE.

I have described some fine localities of this most useful rock. Mr. Jackson, of Chambers, deserves great credit for his efforts to bring this material into use. He works into slabs a portion of the great bed which extends across this part of the State. The rock passes into hornblende, and it is this part of the bed that furnishes the material worked by Mr. Jackson. The slabs are principally used as a substitute for marble, in grave-stones, &c., and are sold at $1 per square foot. They are very durable, and their dark green color produces an agreeable effect. We trust that Mr. Jackson may turn his attention to the softer and finer part of the bed, where the material is far more valuable.

The whiter and softer it is, the better ; it should also be free from iron pyrites, and other embedded minerals. There are few rocks so extensively useful, and applicable to so many purposes. A very considerable trade is carried on in the Northern States in articles manufactured from this rock, such as linings for fire-places, boiler covers, linings for stoves, shields for stove-pipes where they pass through valves, as a substitute for foot stoves, and for a great variety of culinary utensils ; and, above all, for sizing rollers for cotton factories. It is also worked into sinks and watering troughs.

FLAG STONES.

Besides the localities on the Warrior, described in another place, I have now to direct attention to the fine quarry at Tallassee. This place is not more than three or four miles from the Railroad, and it seems to me that Montgomery, at least, could be supplied from this quarry at a moderate expense.

The bedding planes of the rock are so smooth as not to require a touch of the chisel. It splits with ease into the required thickness, and the slabs would only require squaring to fit them for market. Would it not be worthy the attention of the Committee on the Capitol to order the paving of the walks surrounding that building with flags, by way of introducing it into the market?

The citizens would soon appreciate the beauty and comfort of having their pavements covered with this fine material.

ROOFING SLATE.

It is to be hoped that a careful exploration of the Buxahatchee Slates will result in the discovery of a suitable quarry of this very valuable material. The quality of the rock is goop enough, and to settle the other questions relating to it, an excavation must be made, so as to show the character of the slate below the surface. There is every inducement for the proprietors to make this trial.

Mr. LIEBER reports the existence of slates in Talladega. A black slate occurs West of Col. HILL's plantation, and another South of the plantation of Judge BOWIE. The black variety seems to split with more ease than the other. These, however, belong to a different formation.

MATERIALS FOR LIME-BURNING.

I have great pleasure in stating that we are at length about to remove the reproach to our enterprise and industry, of importing so common an article as lime, whilst our State abounds in the best materials for its production.

A few years ago we had scarcely anything deserving the name of a lime-kiln; had we been the inventors of lime-burning, our kilns could not have presented a more primitive appearance. And even at this day, many of those situated at the most important localities are so badly constructed as to deprive the owners of all the advantages that they would otherwise possess. The cheapness of the fuel is more than counterbalanced by the quantity consumed and the labor of procuring it, to say nothing of the loss from imperfectly burned lime.

It was with no small degree of pleasure that I examined the kiln erected near Montevallo, by the Shelby Lime Company. This kiln combines all the improvements introduced into modern lime-burning—improvements that I have endeavored to press upon the attention of the lime-burners of the State. This kiln leaves nothing to be desired, and the Company have conferred a public benefit by its erection.

Since my first visit to this locality, two additional kilns have been erected, and all are now in full operation. The Company have also put up machinery for the manufacture of barrels for the transportation of the lime to market. This is a great improvement upon the old mode of using boxes for the purpose, which, to say the least of them, are inconvenient to handle.

I intended to give a plan of the kilns in use here, but I suppose that every one intending to begin the business of lime-burning will visit this interesting establishment and examine for himself.

The following letter, kindly furnished by Mr. Lapsley, will show the prospects and plans of the Shelby Lime Company:

SELMA, December 21, 1855.

PROFESSOR TUOMEY—*Dear Sir*:—It affords me pleasure to comply with your request, to furnish you with such information as I can in relation to the manufacturing of lime by the

Company of which I am a member—the Shelby Lime Company.

The Company is under the management of Mr. John McGregor, an experienced and skilful lime manufacturer from Vermont. The lime is burnt in a kiln (on the perpetual plan) invented or improved by Mr. McGregor. The cost of the kiln is about $600 or $650. The lime is drawn from the kiln at intervals of about eight hours, and is burnt thoroughly and in a superior manner. Each kiln is capable of turning out about two hundred bushels of lime in twenty-four hours, with a consumption of from 2½ to 3 cords of wood. Any good hard wood, properly seasoned, will answer; but an intermixture of good dry pine, is better than all or any other description of wood in the country—a strong hot blast being required. It is evident that lime burnt in this manner must be superior, as a whole, to lime burnt in the ordinary method, requiring four or five days to burn a kiln. By the latter mode, while a portion of the lime—that nearest the fire—is burnt too much, that near the top and sides is generally not burned sufficiently.

This Company have an abundant supply of superior stone and timber. Their kilns are situated on the Alabama and Tennessee Rivers Railroad, about six miles above Montevallo. They have had one kiln in operation for about eight or ten months, and will soon have three others; and they are about putting up machinery to manufacture barrels and casks to put the lime in for shipment.

It is their aim not only to supply the country adjacent to the Railroads leading from Selma, but they expect to make large shipments to Mobile and New Orleans; and hope, (with others who may embark in the same business within this State,) to supply all that may be required in Mobile. With the favorable rates of transportation established by the Railroad Company on this article, and the arrangements they are preparing to make for transportation by the river, they confidently expect to be able to compete successfully with the

northern lime, at least in Mobile, and probably in New Orleans; and in fact to furnish lime in the first named city decidedly superior to the great mass of the lime brought from the North, and at less than the average prices there.

The Shelby lime has been largely used in this place, and in some other places, during the last year, and so far as I have heard is universally liked; it is preferred to the Pennsylvania and Maine lime, such large quantities of which are annually imported into this State. Indeed, it has been pronounced by competent judges equal to the New York "Bald Mountain" lime, which is imported into New Orleans in limited quantities, and is sold there, principally to sugar planters for the manufacture of sugar, at more than double the price of the Thomaston and other northern limes.

I have no data by which to ascertain the quantity of lime sold annually in Mobile, but it is estimated at about sixty thousand barrels; while in New Orleans the quantity is estimated at several hundred thousand barrels. I have heard it estimated as high as five hundred thousand. Heretofore large sums of money have annually gone from this State to pay for this indispensable article, mostly brought from the North, a distance by water of from two to three thousand miles. The same section can be supplied with a superior home-made article, at about half (maybe less) the average cost of the northern lime. Thus, not only will home labor and enterprise be encouraged, with a great saving in expense to those who encourage it, but a large and constant drain of money will be saved to the State.

It is the expectation of the Shelby Company to furnish large quantities of lime for fertilizing purposes; and to encourage the use of it in this way they intend, as soon as their arrangements are completed, to offer it at prices so low that all who desire to use it, (when the cost will not be too greatly enhanced by the distance of transportation,) can afford to do so. I am unable as yet to state how low lime can be afforded for agricultural purposes; but it is estimated that it can be delivered on the cars at

from $2 50 to $3 00 per ton. The managers of the Railroad, for the accommodation of planters and others who desire to use lime as a fertilizer, have fixed a lower and very reasonable rate of charges for lime to be used in this way. If, as is probable, the people should be induced to make a free and general use of lime, the Company will in the end be more than compensated by the increased fertility and production of the country tributary to their Railroad.

The development of lime on this Railroad, is but one among many evidences daily becoming more striking, of the vast benefits of Railroads to a country. Without a Railroad penetrating a country where limestone abounds, Alabama would probably have remained, to the end of her career, dependent upon the far distant North for an article of general and prime necessity, with which she may now not only supply herself, but other and less favored neighboring States.

But, contrary to my purpose, I find myself entering upon a theme which hardly admits an end—the benefits of Railroads, on which of course I cannot expect to enlighten you.

Very respectfully yours,

J. W. LAPSLEY.

The great drawback and hindrance to every attempt to open up the vast resources of Alabama, is the enormous cost of transportation.

With deposits of iron and coal that astonish every one but ourselves, we are satisfied to submit to the enormous drain upon our resources caused by importing the very articles of which we ought ourselves to be the exporters. Take, for example, this single article of lime, and we find that there were imported into Mobile, in 1852, 31,000 tons. It is greatly to be desired that our other railroad directories would follow the example set by the Alabama and Tennessee Rivers Railroad. Cheap articles, such as lime, iron, and coal, must not be expected to yield revenue to the road by high tolls, but by the quantity transported

over the road. It is clearly the policy of our railroads to encourage in its infancy a trade, that is in its nature expansive to an incalculable extent.

Specimens, characteristic of most of the important beds of limestone in the State, have been analyzed, and the results of some of these examinations are to be found in the preceding pages. For other analyses, many of them of materials well adapted to the preparation of lime, see Dr. MALLET'S Report.

LIME-BURNING WITH BITUMINOUS COAL.

Since my last report, I have witnessed the operation of burning lime by means of bituminous coal. The kiln is of the simplest form, differing little from those most commonly used in the State. A sufficient quantity of wood is placed in the bottom of the kiln to begin the ignition; upon this a layer of limestone is placed, and then alternate layers of coal and limestone until the kiln is charged. As the lime is properly burned, it is drawn off as usual, and additional layers of stone and coal supplied at the top, and the operation is continued without interruption, as in every perpetual kiln.

Of course the proportion of coal will depend very much upon the character of the stone used. On James River and Kanawah Canal, where I saw hydraulic limestone burned in this manner, it required one bushel of coal to twelve of stone.

It scarcely requires a word to be said to show the advantage of this mode of manufacturing lime for market. The Cahaba coalfield has along its Eastern boundary strata of excellent limestone, every where accessible, and at Pratt's Ferry lime has been burned for market, and transported on the river to Selma and intermediate points.

Throughout the North the screenings of anthracite coal, under the name of coal dust, is used for lime-burning; and I cannot see why the refuse at the Cahaba coal pits may not be used for the same purpose. The trial should be made on the Cahaba,

with some of the most convenient limestone. But even if the slack coal did not answer, the best coal is so much cheaper, to say nothing of its greater convenience, that there can be but little doubt that if once fairly tried, it would supersede the more costly material of wood.

HYDRAULIC LIMESTONE.

When pure limestone is calcined and reduced by moisture, or the application of water, it produces a paste or mortar, which does not harden in water. Limestone of this kind, containing but a certain amount of impurities, is that used for the production of the lime for ordinary architectural purposes. But when the impurities consist of clay, or silex in a certain state of division, and are present in the proportion of 10 or 15 per cent. of the limestone, it produces what is called a meagre lime, which has the useful property of setting under water, and for this reason it has received the name of hydraulic lime. The presence of magnesia, in proper proportion, imparts hydraulic properties, and doubtless the reputation of the dolomites of the State, for producing excellent mortar, is more or less due to this fact.

The limestone from a quarry near Talladega, the property of Dr. McKenzie, is, to a considerable extent, hydraulic.

Artificial hydraulic limestone is made by mixing the proper proportion of clay with ordinary limestone, and calcining the mixture.

Some specimens of the rotten limestone of the cretaceous formation are feebly hydraulic, and with the addition of a little more clay the rotten limestone of Jones' Bluff, would make a good cement.

In the artificial formation of hydraulic cement, the limestone and clay are ground and intimately mixed, the mass is then moistened, made into balls and calcined. With our rotten limestone this would be an easy process, and the Bluff just mentioned offers a most convenient locality for an experiment.

Hydraulic limestone is not to be recognized by its external characters, yet a little practice will enable any intelligent person to distinguish between common and hydraulic limestone.

The rock to be examined is broken into fragments about the size of a hickory nut. A common fire will answer the purpose of calcination. The fragments are kept at a red heat for about two hours, or until the greater part of the carbonic acid is driven off. If the stone under experiment be common limestone, it will fall to powder when moistened with water, but if it have hydraulic properties no such change will take place. Supposing the calcined fragments to remain unchanged after being moistened, there is then good reason to think that they are hydraulic; and the trial may be continued by pulverizing a few of the fragments. The powder must be very fine, and free from grittiness when a little of it is taken between the finger and thumb. The powder is next made into a paste with as little water as possible, and made up in balls of about an inch across. These very soon become sensibly hot, and in a short time become hard. After the balls cool, they are put into water, where, if the stone has hydraulic properties, they remain without swelling or becoming soft. The time of setting or hardening will differ with the sort of stone; it may take place in a few minutes, or it may require many days. The time of setting is greatly retarded by using more water than is necessary to convert the powder into a stiff paste; the proper quantity of water appears to be about one-fourth by measure of that of the cement powder. It is also proper to observe, that there is greater danger of over-burning the stone than of falling short of the proper point.

This is the simple practical mode of determining the hydraulic properties of limestone, and the process of preparing cement for market is nothing more than the same thing repeated upon a larger scale.

The stone is calcined in kilns of the usual construction, and in the manner of ordinary lime-burning. The calcined stone is

ground in a common grist mill, and carefully barreled so as to exclude the air, for the cement is greatly deteriorated by moisture, and should be used as soon as possible after it is manufactured.

HYDRAULIC LIMESTONE OF SHELBY.

On Buxahatchee creek I found a piece of limestone, near the slate quarry already described, which, on examination, proved to be decidedly hydraulic. The fragment was brought down by the stream during a freshet, and must have been detached from the rock exposed higher up the creek. I examined portions of this rock from the bed of the creek, and from some other localities without finding the origin of the fragment in question. Much of the rock on Buxahatchee has a sufficient amount of clay to constitute a hydraulic limestone, but it is disposed in thin layers, and not intimately combined with the lime.

A careful search of this locality will, I am sure, result in the discovery of a bed of cement rock. About three or four miles above Centreville, on the road to Montevallo, a bed of clay slate is seen, which extends to the Coosa. Parallel with this slate there occurs at intervals a bed of black limestone, portions of which are pure enough for marble, and other portions possess hydraulic properties.

The best locality that I have observed is on Six mile creek, on the land of Mr. Carter. On a little stream that flows into the creek, thick ledges of a dark colored limestone with white veins, may be seen, and this on examination proves to yield a lime of hydraulic character.

FIRE-PROOF MATERIALS.

Besides the fire-proof stone furnished by the mill-stone grit, I have pointed out other localities near Columbiana. From one of these, McClanahan's furnace is supplied with hearth stones, for which the rock answers very well.

In Clarke County there is a bed of finely divided siliceous matter, which is known there as chalk; from some experiments in a small way, I infer that this substance will answer as the basis of a clay for the manufacture of fire-brick. It is itself infusible, and only requires the addition of a little clay to give it tenacity. It is found in great quantities, associated with the buhrstone of Clarke.

PORCELAIN CLAY.

Beds of excellent clay for ordinary pottery are common. But till recently the existence of porcelain clay in the State was not known. The bed at Green's, north of Jacksonville, is pure kaolin; it is perfectly white, and, should it prove to be in quantity, it will be in time valuable. For analysis see p. 87.

Another bed of this clay is found near Louina, Randolph County, the quality of which is excellent:

(Composition in 100 parts.)

Combined silica	19.85
Free silica	17.44
Alumina	31.92
Per-oxide iron	trace.
Potash, lime, and magnesia	.72
Water	15.09
Undecomposed mineral	14.28
	99.30

The absence of iron in this clay is a most favorable condition. When Randolph has a railroad communication with the rest of the world, the discovery of porcelain clay in the county will be properly appreciated, and Louina may one day become the seat of a great porcelain manufactory.

Several of the beds of quartz rock, described in this report, are

sufficiently free from iron and other impurities to furnish a good material for the manufacture of glass.

GRAPHITE OR PLUMBAGO.

Pure graphite is by no means common, and, as its value depends upon its purity, a bed of pure graphite would be exceedingly valuable. The best graphite in the State is that found below Tallassee; the pieces found here are sufficiently pure, but their size is too small to give them great value. It is greatly to be desired that the owners of this locality should make some excavations to determine whether workable graphite may be found here or not.

There is brought into the market, for the purpose of relieving friction in machinery, a substance under the name of black-lead which has not a particle of that mineral in it. Having been ground, it is soft and rather unctuous to the touch. It is derived from a black slate found in various parts of the State, and frequently mistaken for black-lead or graphite. See Report of chemical department.

MATERIALS FOR MILLSTONES.

The granite of the State is used for the construction of millstones. A regular manufactory is in operation at Blake's ferry. The stones are made 18 inches in thickness, and vary in price according to their diameter. The following are the prices:

3 feet in diameter		$40 00
3 ft. 6 inch.	"	50 00
3 ft. 10 inch.	"	65 00
4 ft.	"	72 00
5 ft.	"	100 00

The conglomerate near Columbiana will furnish good material for this purpose. For grinding corn I suppose these granite

millstones answer sufficiently, but for wheat the buhrstone is greatly to be preferred.

In the exploration of the lower counties, I observed excellent quarries, from which an inexhaustible supply of buhrstone may be procured. Nor can the use of the rock be considered in the light of a mere experiment, for most of the grist mills of that region are supplied with them.

Were the imported French buhrs cut in one solid piece as these are, they would not in any respect be superior, but they are made by first selecting pieces of the best quality, giving them the proper form, and then uniting them by means of cement, and binding them with iron hoops. In this way stones of uniform and good quality are produced. But our people, on the contrary, must have the stone all in one piece, and as it is not easy to find a bed with such large pieces uniform in every respect, they cannot expect to have them of the best quality; nevertheless their excellence is extraordinary.

Chapter Fifth.

Section from Tuskegee to Chunnennugga—Limestone of the Ridge—Section from the Ridge to Fort Gaines—From Fort Gaines to the Conecuh River.

At Three mile creek the umber-colored loam, so frequently found at the upper edge of the cretaceous rocks, makes its appearance, and on Calecbee creek we find the first appearance of the cretaceous limestone. It is white, pretty hard, and is found outcropping on the hill side.

At LUCAS' steam mill an artesian well has been bored, and water found at a depth of 63 feet. From this point to the Ridge bored wells are common, although water rarely comes nearer the surface than 50 feet. From that just mentioned, the wells increase in depth to the Ridge, when near Union Springs the depth is 612 feet. This shows very plainly that the limestone gradually thins out towards Caleebee creek.

At Crawford's, on the Tuskegee road, hard limestone, containing cretaceous fossils, is bored into. It is not, however, until one reaches within 7 miles of Chunnennugga that characteristic prairie soil is seen. The first black soil occurs on hill sides, and is underlaid by the yellowish loam. On the fine plantation of Dr. POWELL an excellent opportunity occurs for observing the cretaceous soils north of the Ridge. The surface is undulating, and covered with black and yellowish soils. The bald spots are covered with ash-color soil. It is curious to see the thick growth of hawthorns that occupy the verge of the black soil where it surrounds the bald places produced by denudation. The whole

of the limestone near the surface is broken up by laminæ and joints, but yet contains fossils in place, and numerous concretionary nodules of lime, so white as to resemble caustic lime. This stratum is about 20 feet in thickness; this is called by the well-borers clay, and is the limit of the "sepe"-wells. The water percolating through the fissures, furnishes these wells. Under this the rotten limestone assumes its usual characteristics.

Below the plantation house a good opportunity is afforded of seeing the junction of the post-oak and ordinary soil of the prairie, the two having entirely different sub-soils. The land slopes towards Town creek, and in the lane a ravine has been formed, where we may observe—

1st. The fissured rock mentioned above, which is found on all the bald spots.

2nd. The sudden termination of the preceding stratum, as if it were washed away by water.

3rd. A bed without fossils, which appears to be an accumulation of lime and clay with organic matter, deposited after the removal of a portion of the fissured rock, the sub-soil of the post oak soil.

4th. Town creek, which has been enriched by a tributary of the Conecuh turned over the ridge for economical purposes.

In Macon county, wherever I have seen, the black prairie soil is found on the hill sides, and even tops, and rarely in the depresssions, a fact of some importance in connection with the theory of these soils.

After passing over this fine agricultural tract, the most remarkable physical feature of the cretaceous formation, Chunnennugga ridge, is reached. This has a N. E. and S. W. direction, and is the water-shed between the streams that flow into the bay of Mobile, and the waters of Pensacola bay. It is elevated 600 feet above tide at Mobile. Towards the South it sinks gradually, but on the North it terminates abruptly. It is made up of beds of sand, loam, clay, and limestone abounding in well characterized cretaceous fossils.

At the Rev. Mr. STEWART'S mills a bed made up of clay and sand, and a thick bed of sandy clay with fossils occur, and in the mill-race a bed of marl. These beds are below those constituting the ridge proper.

At Eanon similar beds occur, and may be examined at the spring. On the top is a thick bed of white sand; under this is a stratum of sienna-colored loam, with limestone in water-worn masses. The water issuing from all the bluffs contains lime in solution.

This dark-colored stratum is found below Mr. STEWART'S house on the ridge, and has been reached in the well on his plantation. At the other extremity of the ridge, at Union Springs, a remarkable stratum of fetid limestone crosses the road.

The North side of the ridge presents the appearance of an ancient sea beach, water-worn detached masses of limestone and calcareous sandstone, embedded in sand, and presenting the appearance of having been washed for ages by the ocean waves. The limestone is filled with fossils, mostly with the valves separated. These remarkable beds differ very materially in chemical composition, a fact which should be borne in mind when they are selected for lime burning.

1. This is a compact arenaceous variety, exposed on the road side:

(Composition in 100 parts.)

Carbonate of lime	53.66
Carbonate of magnesia	.97
Alumina	.27
Per-oxide of iron	.22
Insoluble matter	44.60
	99.72

2. Specimen from the crest of the hill West of the public road. It is compact like the preceding, with black specks disseminated through it, and white fragments of shells:

(Composition in 100 parts.)

Carbonate of lime	46.96
Carbonate of magnesia	1.19
Alumina	.78
Per-oxide of iron	.26
Insoluble matter	50.61
	99.80

3. Taken from the part of the stratum near the old kiln. It is more fossiliferous, and the fossils retain their form:

(Composition in 100 parts.)

Carbonate of lime	88.82
Carbonate of magnesia	2.18
Per-oxide of iron and alumina	.94
Phosphoric acid	.23
Insoluble matter	7.20
	99.37

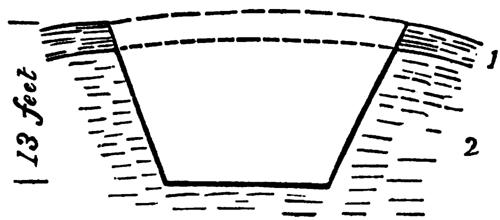
These beds of limestone are covered with sand, which forms the sub-soil of the ridge. The natural forest growth of oaks still remains untouched by the axe, as the sterility of the soil offered no temptations, and the ridge furnishes most desirable sites for the residences of the proprietors of the surrounding plantations. A taste for horticulture seems to prevail in the pleasant society of the place; and besides many private ones, there is a public garden kept in good order.

Below the ridge a remarkable change takes place in the cretaceous rocks; instead of the rotten limestone of the Western part of the State, the streams that flow into the Chattahoochee from the East have their beds in a dark colored micaceous marl. This is as uniform on the East as the grey rotten limestone is on the West.

After descending from the ridge it is seen in Mr. CUNNINGHAM's well, and along the line of the railroad it is overlaid by the whitish calcareous rock, already mentioned, which is here called joint clay. The whole country towards Columbus is covered with pines, and one would scarcely suspect that the sub-soil is calcareous.

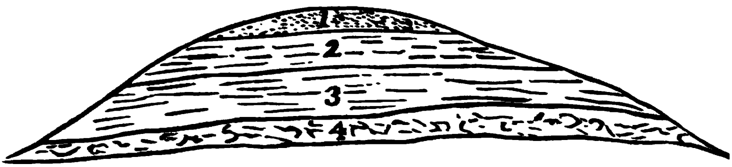
The following is a cross section on the Girard and Mobile Railroad:

(Fig. 25.)



The upper stratum (1.) is 2 feet thick, and consists of yellowish-brown loam. (2.) Whitish "joint-clay" or marl. It is curious and interesting to find the roots of pine trees penetrating this many feet in depth. In various places between this and Silver Run, the railroad cuts exhibit similar sections. At Sheppard's this joint clay has proved very troublesome, for when a cut was made to a certain depth in it, slides took place as if the joint clay were nothing but incoherent sand, completely filling up the cut. The underlying rock here is a dark colored marl. In one of the cuts a bed of hard shell-rock occurs; it is about 18 inches thick, and made up of almost a single species of shell—the Exogyra costata,—numerous rounded greenish pebbles, grains of green sand, and the teeth of fishes; the whole cemented together into a solid stratum. This would make good lime.

(Fig. 26.)



1. Soil.
2. Joint clay.
3. Dark-colored marl.
4. Stratum of shell rock.

The railroad cuts approaching Columbus exhibit beautiful examples of false stratification in the beds of sand and clay. Between Uchee creek and Columbus, drift is found on the hill sides composed of sand and pretty large pebbles. On the river, as usual, there is a fine terrace covered with rich soil.

At the falls at Columbus, gneiss, like that at Wetumpka, occurs. It is much contorted, and curved bands of white felspathic gneiss appear on the surface, which give the rock a remarkable appearance. The rock is quite hard, and rings to the hammer. A little below the falls the rock is felspathic, and is consequently decomposed to a considerable depth on the right and left bank of the river, and gives rise to different colored clays.

The city of Columbus is situated on the second terrace or plateau from the river, which presents a beautiful site for a city, whilst the Chattahoochee furnishes a vast amount of power at the falls.

At Mr. William Hust's a bed of poor green sand occurs, which is full of echinoderms. I am indebted to Mr. Joel Hust for a knowledge of many interesting localities in his neighborhood. One of these, on little Cowikee, is interesting for the fossils found there; with the exception of some cephalopods, the shells are for the most part lamellibranchiata. The marl is more calcareous than that found on the ridge; it is almost black when wet, but dries an ash color.

Between this creek and the ridge the country is undulating, with extensive plains covered with pines. It is remarkable that the white bed or joint-clay is only found capping the little elevations, and is not at all found on the streams. It seems that after the deposition of the joint-clay, the denudation of the whole country took place, leaving patches of this bed on the elevations, and nowhere does its thickness exceed 14 feet.

At Rev. Dr. DAWSON'S mill marl of similar character is found. Still lower down the creek it becomes much thicker, often rising into banks 3 feet in height.

The fossil fauna includes a considerable number of Cephalopods. The bivalve shells have their valves for the most part disunited.

The soil of the region is quite remarkable. The immense pine levels, although light, instead of being barren, produce excellent crops, far better than lands of similar appearance in other parts of the State. Occasionally a depression occurs in these levels, which is covered with moisture-loving plants, and a peculiar species of swamp soil, a foot or two in thickness, is produced. Such spots, when properly drained and the soil brought into proper cultivation, cannot fail to be productive.

At the mouth of the Uchee the river banks are composed of clay without lime; the clay breaks up into small irregular fragments having a conchoidal fracture and dries quite hard; it extends 4 or 5 miles nearer Columbus. At Fort Mitchell, 3 miles above Uchee, lime was burned from a bed composed of a species of fossil oyster.

Marl is found where the Glennville road crosses the creek.

At JOHNSON'S mill a fine exposure is produced by the denuding action of the creek on the bed of clay just mentioned. It is cut up by long joints, and fissures filled with sand stone extend across the surface. Near the cotton gin the claws of crabs and a few other fossils are found.

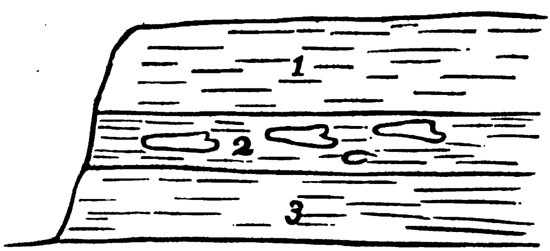
On Oswitchee bend thick beds of ferruginous conglomerate are found on the river bank, overlying the blue clay in a thick solid

ledge which extends across the river. It is found up and down the river for the distance of half-a-mile. At Major WRIGHT'S mill this same clay occurs—with but little lime; but on Dry creek in several places, and on Ohaga creek, very good marls are found from the ford downwards. Towards the top it is poor, but at the level of low water it is better.

On the road to Eufaula a bed occurs which contains cretaceous fossils; and at the bridge over Hatchoechubbee a fine locality occurs, where an interesting section of the rocks of the country may be seen. The bluff is 40 feet in height; the upper and lower portions contain no lime, but for about 10 feet in the middle it is quite rich. The fossils found here are identical with those noticed on the Cowikee.

SECTION ON HATCHEECHUBBEE CREEK.

(Fig. 27.)



1. Clay and sand.
2. Marl, with concretionary masses of limestone.
3. Clay without lime.

At the mill on Little Barbour creek the calcareous portion is confined to a thin seam, covered by a thick bed abounding in iron pyrites, which by its decomposition produces sulphate of iron, that covers the surface with a white efflorescence.

On the Wessufka, a fine locality is found at the old mill, where the marl is 15 feet thick. At Dr. WILLIAMS' bluff, at the

landing on the river, it is 30 feet thick. It occurs again on the Georgia side.

The same bed is again exposed on Big Barbour, two and a half miles from Eufaula.

BLUFF AT EUFAULA.

The wells at Eufaula pass through 30 feet of sand loam, which constitutes the terraces upon which the town stands; this is underlaid by 10 inches of laminated marl; this underlies the water-bearing stratum.

Below this, the bluff is composed of black calcareous sandy beds, dark colored, and containing ledges of indurated marl. The bluff is 120 feet in height.

Back of town, at the bridge over Big Barbour, the marl occurs in a bed 15 feet thick, and is found extending downwards to the mouth of the creek.

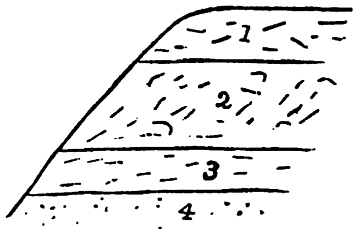
Marl and marlstone also occur on Dr. THORNTON's plantation, and what is not a little curious, masses of a siliceous rock resembling buhrstone are found on the hill above the lowgrounds. At HAMILTON's the micaceous clayey marl is found, abounding in fossils.

Near Mr. ALEXANDER's mill a curious bed occurs made up of clay concretions.

WHITE LIMESTONE AT STEIN'S.

At Mr. STEIN's the white eocene limestone is finely exposed at the lime kiln. The following figure represents a section at this place.

(Fig. 28.)



1. White soft limestone like that at St. Stephen's.

2. Hard limestone, with casts of fossils, 100 feet thick.*

3. Is a rough and water-worn rock that is prominent on the river.

4. Marl with casts of Turritella Mortoni; it consists of a hard and soft layer; the former is full of silica in grains, which remain on the surface when the lime is washed out.

Although the kiln here is a poor one, a considerable amount of lime in burned.

OTHO TO FORT GAINES.

The section between these two points is interesting, as it includes the junction of the cretaceous and tertiary rocks.

[*It is much to be regretted that the portion of manuscript containing the description of this section, and of that from Fort Gaines to the Conecuh River, is missing. With respect to this region of the junction of cretaceous and tertiary formations, see Mr. Thornton's Report at the end of this volume.*]

* Sic in M.S. orig.

Chapter Sixth.

The Newer Deposits of the State.

In a previous Report I described certain beds of loose pebbles, sand &c., that are scattered over the surface of various parts of the State. They are found on the highest elevations, and are strewed along the vallies. Across the middle of the State and North of the verge of the cretaceous rocks they are found in greatest force. Tuskaloosa stands upon these beds, as do the cities of Columbia, S. C., Petersburg and Richmond, Va. Washington and Baltimore have also their foundations on these strata.

In Alabama they contain no boulders of any size, and I have only observed angular fragments of sandstone where the beds cover the outcropping edges of the coal measures.

The greater part of these materials are siliceous, composed of quartz, chert, hornstone, and not unfrequently pebbles of jasper and agate, that had their origin in the northern part of the State, or perhaps still farther north in Tennessee and Kentucky. It is not a little remarkable that, although fossils derived from palæozoic rocks are often found, limestone pebbles never occur; even the fossils are always silicified, being derived from the cherty rocks. Now as these beds often rest upon limestone and have undoubtedly travelled down through the limestone vallies of the State, it is surprising that not a vestige of limestone is ever found among them. Can it be that the water, charged with carbonic acid, percolating through these porous accumulations could have removed every particle of lime. The fossil common to the entire deposit, wherever I have seen it, is silicified wood.

There is a remarkable uniformity in the minerals composing these accumulations, yet a close observer may see indications of the source from which they are derived. The jasper, agate, chalcedony, hornstone, and fossils, of the beds around Tuskaloosa, are found in place in the cherty rocks of the northern part of the State, and in some of the beds west of the Cahaba I found fragments derived from the granitic rocks of the north-eastern part.

The deposits every where show the action of water; they are often obliquely laminated, and sometimes beds of clay occur between the strata of sand and pebbles, indicating a short period of repose in the agitated waters.

North of the paper mill at Tuskaloosa, a bed of swamp mud four feet thick, outcrops at the base of a bank in a ravine, covered by a stratum, 20 or 30 feet in thickness, of the usual materials of these beds. The remains of grass, charred wood, compressed stems of woody plants and the elytræ of insects, are found abundantly.

I have elsewhere mentioned that these are among the newest beds of the State, excepting the alluvial, now in process of formation; but I hesitated about referring them to any particular period. I now think that they belong to the *drift*, although having but few points of resemblance to that formation at the North. *There* considerable deposits are thrown together, containing large angular and rounded masses of rock, that could scarcely have resulted from the action of water alone; *here* the largest of the rounded fragments seldom, if ever, exceed six inches in diameter, and there are no angular masses excepting in the instances that I have mentioned, and the action of water in motion is everywhere pressed upon one as the sole transporting force.

A remarkable feature in the distribution of this formation is its appearing in greatest force parallel with the tertiary plane of the United States, and crossing the rivers at their falls. These beds are indeed scattered farther South, but their greatest accumulation takes place here, the thickness being often 100 feet. On

account of their position in relation to the edges of the tertiary fossiliferous beds, they have sometimes been confounded with the loose gravelly strata of the latter, but they can everywhere, so far as I have examined them, be separated from them ; in Virginia, around Petersburg, by the existence of beds containing eocene fossils ; in South Carolina, in the same way; and in Alabama by their mineral composition, and by the existence of water-worn palæozoic fossils contained in the drift, as well as by its distribution over the surface of the newer beds.

If the Southern drift be at all connected with that of the North, it may be explained by supposing that the Northern glaciers suddenly melted, and that the water thus liberated in immense volume took a Southern direction, carrying with it the debris torn from the surface over which it passed, until it met the tertiary sea, upon the shores of which its burden was deposited. It is difficult to suppose that any force acting upon hard siliceous fragments for so short a time as that necessary for their transportation from North to South would so completely round and polish them, and if we suppose these materials to have been already water worn and scattered over the surface, and that they were merely brought together by this force, still one would suppose that a very considerable quantity of angular fragments would also be torn up and transported with the rest, which is not the case. But after all, we know too little of the grinding force that may be exerted by a mass of loose materials 100 feet in thickness when in motion.

This theory would sufficiently well account for that enormously long ridge of drift extending parallel with the Atlantic coast. For the moment the current entered the tertiary sea its velocity would be checked, and the greater part of the transported detritus deposited. It can be demonstrated that this accumulation took place at a time when, if our Southern rivers existed at all, they did not occupy their present beds, for they have almost all cut through the drift, after its deposition. In supposing that the drift was deposited on the margin of the tertiary sea, the

difficulty meets us, that in the Southern drift we have no marine remains, nor in truth organic remains of any sort, beyond the silicified wood already mentioned; and yet beds of clay and fine sand are deposited in a manner that indicated a period of repose, and conditions favorable to the preservation of organic remains, if any organism existed in the sea. The only way by which I can account for this absence of every vestige of life in a sea that once teemed with life, is by supposing that before the drift period the bottom of this sea had been elevated and converted into dry land, and that at the commencement of the drift period a depression of the land took place, that the time between the influx of the sea and the deposition of the drift was too short for marine animals even to have commenced a colonization; and that the land was again elevated into its present position, and subjected to long continued denudation, which produced its present configuration; that after this elevation the rivers excavated their present channels. It must obviously be very difficult to assign the limits of the Southern drift, for it is found scattered over the States, the materials becoming smaller as we proceed South, till they mingle with the sands on the coast, from which they cannot be distinguished. The remains of the mastodon are found on the surface, or are washed out by the streams.

FOSSILIFEROUS BEDS OF THE POST-PLIOCENE.

The almost entire absence in Alabama of the fossiliferous beds found elsewhere along our coast, is not a little remarkable. Parallel with the Atlantic coast, from Maryland to Georgia, beds are found that contain fossils all identical with those now living in our seas. The Gnathodon beds of St. Mary's, Md., the fossiliferous beds around Charleston, and those on the coast of Georgia, are all examples. These beds, although enclosing species identical with our present fauna, are for the most part elevated above the present sea bottom, indicating a comparatively recent ele

vation of our coast. There is nothing like this found on Mobile bay, beyond a mere indication that such a state of things did once exist there.

The stranger, acquainted with the flat, low country bordering the coast of the Southern Atlantic States, is surprised to find in Alabama nothing corresponding to what is called the "low country" of those States; nothing like the great rice region of South Carolina, nor the level belt of country, elevated but a few yards above tide, and extending back for miles, and reaching from Charleston to Albemarle Sound; but on the contrary, as he approaches Mobile, he finds the sand hills which he had seen at Fayette, N. C., and extending across the middle of South Carolina.

The bluffs on the Eastern side of Mobile bay are from 20 to 30 feet in height, and the land a little back from the water's edge is 100 feet. On the West, after leaving the plateau upon which Mobile stands, we reach a sandy ridge that rises to a height above tide of 215 feet, which is within 24 feet of being equal to that of Tuskaloosa; this fact was ascertained by actual instrumental measurement. This elevation is not that of a mere isolated point, but of a ridge extending to Grand bay, and forming the water-shed between the streams emptying into Mobile bay and those tributary to east Pascagoula river.

Nor is the resemblance found alone in the soil and elevation; the flora also indicates it. Every one who has travelled in the Southern States knows that the botanical character of the "sand hills," or middle portion of the country is entirely different from that above and below it.

Among the plants characteristic of this region are *Quercus Catesbeii*, *Lupinus*, *Asclepias amplexicaulis*, and what is still more striking, *Ceratiola ericoides* grows with great luxuriance, and most abundantly at Point Clear. I believe this plant has never been observed beyond the range of sand hills which extends from Camden, S. C., to Augusta, Ga. In truth, the whole flora is that of the region to which I have just alluded, and the

only place around Mobile at which I have observed the plants of the low country, is a little low strip along the base of the ridge, and through which the prolongation of Government street passes. Another fact which I observed along that fine sweep of the bay between Point Clear and Mullet Point, is that the sand is quite coarse, approaching gravel, instead of the very fine grains that constitute the coast sands elsewhere. At Mullet Point, masses of ferruginous sandstone extend from the bank in thick ledges, that protect the land at that place. This sandstone is found in the sand hills from North Carolina to Alabama. So far as durability is concerned, it makes an admirable building stone, and was used for that purpose by the early Spanish settlers. Between Bon Secour bay and the Gulf, the land is composed of sand blown up from the Gulf, forming hills or dunes, which are now permanent and covered with numerous plants, among which are conspicuous *Quercus pumila*, *Q. maritima*, *Ceratiola ericoides*, and the sea-side loving *Uniola*. For a hundred yards the beach is composed of loose and moving sand. Sand island on the west side of the inlet is the counterpart of this. The inlet is narrow and the contour of the shore shows very distinctly the influence of the Gulf stream; on the bay side the encroachments expose good sections.

The bluffs opposite Mobile, and north of Point Clear, are composed of red and yellowish clays and sand; their vertical fronts indicate an encroachment upon the land on that side, while the accumulating flats about Choctaw point would indicate an equal gain of the land on the west. The bluffs resemble those of the Post Pliocene of South Carolina, but I looked with some care for the fossiliferous beds of that formation without success, and I owe the only evidence of such beds in Mobile bay that I have seen, to the politeness of the Hon. Chancellor Lessesne, who furnished me with a specimen, with this label: "taken from a stratum 3 inches thick, 12 feet from the surface and 3 from the level of the water, in the bank at Yellow Jacks." In this specimen I find ferruginous

casts of *ostrea virginiana*, *cardium magnum*, and a *modiola* resembling *m. demissa*, which I also found living among the oysters. These, it will be observed, are the very shells that one would expect here, for they are now living in the bay. The relative position of these fossils is also that agreeing with the Post Pliocene beds of the coast, which are all elevated above tide level; yet it is not so easy to account for the thinness of the bed and the small number of species.

I picked up on the beach, at the south end of Bon Secour bay the following species now living there:

Cardium magnum;
Arca ponderosa;
Arca transversa;
Arca pexata;
Arca incongrua;
Donax variabilis;
Venus elevata;
Carditamera;
Ostrea Virginiana;
Corbula;
Artemis concentrica;
Natica duplicata;
Strombus pugilis;
Purpura cataracta;
Crepidula convexa;
Teredo.

These were washed up on the beach, and, as a group, represent the marine fauna of the Southern United States.

It would be premature, upon so slight an examination as it has been in my power yet to make, to generalize, but it does appear so far, that that part of our coast corresponding to the Post Pliocene era, with the exception of the seam mentioned, has been removed by the encroachment of the Gulf stream, although at

present and for years past the land has gained on the Gulf at Mobile Point.

GNATHODON BEDS.

I am aware that the beds of "clam" shells in Mobile bay, have been referred to this period, and, knowing that some of them at least had been examined by Sir Chas. Lyell, who came to the conclusion that they were real fossil beds, it will readily be supposed that I examined them with every care. It is proper to state, however, that Sir Charles does not mention having seen any other than a bed between Choctaw Point and Mobile, which is upon dry land.

Before describing the beds that I examined, it may be as well to glance at the delta among which the principal ones are situated· About 30 miles, in a straight line, above Mobile, the Tombigby and Alabama rivers meet, and here the delta of Mobile bay commences. The moment the velocity of the stream is checked the deposition of sedimentary matter begins, a long low tongue of land is formed, which divides the combined waters into the Mobile, and Tensaw rivers, which after meandering through the channels of the delta, are again subdivided into the Spanish and Apalácha rivers. The delta terminates a few miles below Mobile; here the distance from shore to shore of the bay is 7 or 8 miles. The low islands occupying this space are for the most part composed of soft mud, rising occasionally in spots slightly above tide level, but no where affording a solid footing for cattle, although covered with a rich growth of marsh grass, such as *spartina, zizania, &c.* When the land is elevated above tide, as is sometimes the case along the margins, rushes make their appearance, and little clumps of alders and cypress are found; but after the flats rise to the surface of the water, their increase becomes exceedingly slow, as they can then but receive deposits of sedimentary matter at times of extraordinarily high water. They are intersected by numerous channels, and

in these and everywhere else where there is eddy and shallow water in the delta, aquatic plants of the genera *Potamogeton* and *Valisneria* grow in such immense quantity, that it is difficult to propel a boat through the water. The temperature of this stagnant water is often as high as 100 deg. Fahr., (July,) while the thermometer, in the direct rays of the sun in the boat, gave 126 deg. In this heated water I saw vast numbers of *Neritina* feeding on the floating leaves of *Valisneria*, and in the fall, I was informed that the number is prodigious.

The great volume of fresh water flowing into the bay and the very narrow entrance, prevent the water from becoming even brackish at Mobile till late in the season, when the rivers become low. It is for this reason that the wharves of the city are not troubled by that terrible pest, the *Teredo*. In Charleston nothing but palmetto logs or stone can resist its ravages; and the pine wharves of Mobile would not last three seasons.

On the west side of Spanish river, and on the edge of the marsh, a vast quantity of timber, exposing a surface of some acres, is stranded, composed of trees that floated down the river. On portions of the surface a soil was collecting from the decay of the smaller and more destructible drifted materials, and living plants had already taken possession of those parts, so that in a short time the whole will be added to the marsh.

Some idea of the immense quantity of drift wood brought down by the rivers of the State may be formed from the quantity lying along the strand and on the huge wood flat between Choctaw Point and the mouth of Dog river. This timber, submerged and covered in the mud, must add greatly to the solidity of the land forming in the delta. It is in the midst of such land as this that the *Gnathodon* beds, that I examined, occur, but sometimes rising above it as high as 20 feet. It was owing to Mr. HALE's politeness that I had so good an opportunity of observing these beds, and I have only to regret that we should have come to

conclusions diametrically opposite in relation to them.* In Mr. HALE's cabinet I saw shells of the genera *Gnathodon*, *Cyrena*, and *Neritina*, from these beds, together with ashes, charcoal, bones of birds and fishes, taken from a depth below the surface of 12 to 15 feet. Among these relics I also saw a fragment of *pyrula carica* cut into a peculiar shape and perforated artificially, also taken from the *Gnathodon* beds. An instrument similar to this I found myself, 10 feet below the surface.

The beds are scattered over the bay, but, I believe, every where accessible by water; at least that was the case with those that I examined, and I think it will hold good elsewhere. Their area varies from a half acre to ten acres; their form is more or less circular, and some of them are appropriated as market gardens, a purpose which they answer admirably. The first of these that I saw is the property of Messrs. STROUDER and LALLEMAND, to whom I am much indebted for hospitality and facilities for pursuing my investigations. Their garden is based upon shells, and the vast drain, in the form of various vegetables sent to the Mobile market, upon what to a superficial observer would appear but a scanty soil, is supplied by repeated additions of vegetable matter from the surrounding marsh, as well as litter from the cow-house. For the latter purpose principally, 12 beautiful cows were housed constantly, and kept upon hay saved from the marsh grasses. It was curious to find on this lonely and isolated spot, surrounded by impassable marshes, two families living in health and comfort, the result of domestic management and well directed industry. It was a sad commentary on many of our large but miserably managed farms. The produce of this garden is carried in boats a distance of 12 miles to the Mobile market. These beds were originally covered with the native forest trees, and I saw yet standing some individuals of great size and age of our most beautiful indigenous evergreens—*Cerasus Caroliniana.*

*Silliman's Journal, (N. S.); VI; 354.

Were only opportunity afforded of observing the surface, it would perhaps be difficult to arrive at undoubted conclusions as to the origin of these beds, although fragments of Indian pottery* are scattered over these every where. The shells, however, have a very important economic value in their adaptation to road making, and are used extensively for that purpose in Mobile and vicinity, so that when the beds are excavated, sections are obtained that explain most clearly the conditions under which they were placed where we find them. The deposit that I examined was not opened as low as the water line; it exposed, however, a vertical section in the heart of the bed of 10 feet, the whole composed of loose shells of the genus *Gnathodon*, the valves all separated, nor did I find a single pair in juxtaposition. I looked carefully for the two other brackish-water shells, *Neritina* and *Cyrena*, always found at present living with *Gnathodon*; of *Cyrena* I found one or two shells, and not a single one of *Neritina*. Fragments of pottery were intermingled with the shells, and towards the bottom the fragment of *Pyrula*, already mentioned, was found. Pieces of ferruginous sandstone were also found both in the bed and on the surface. This sandstone is found very abundantly on the sand hills, as well as at Mullet Point. The pieces often presented marks of abrasion. Intermingled with the shells was a black earth, easily recognized as the product of the action of lime on organic matter, as may be seen on the surface of any long exposed heap of shells, but entirely different from the sedimentary matter of the Bay, or indeed of any other sort. The section presents some appearance of stratification, that is, there is a layer of shells, and then the black earth

*It is remarkable that, where every other vestige of our aborigines has disappeared, these potsherds remain to attest their existence. The Indian pottery found in Alabama always contains pulverized shells mixed with the clay of which it is composed. The vessels are often of considerable size. They are often ploughed up containing the entire adult human skeleton. They are for the most part rudely carved on the outside, but never glazed.

becomes more abundant, and then another layer of shells and so on. But about 6 feet from the top of the bank a layer of a few inches in thickness occurs, composed of ashes, burned lime, and fragments of charcoal, and this is not confined to a single spot, but extends for a yard or two across the section; this is covered with the usual layers of shells and earth. Here was at once the explanation of the ashes and charcoal that I had already seen in Mr. HALE's cabinet.

I have now before me shells collected here, some partly burned, and others converted into masses of caustic lime, with wood ashes and charcoal. I do not see how it is possible to come to any other conclusion, than that this bed was of Indian origin, and if this, certainly the others in the bay.

It is easy to see how the whole was produced; a small portion of the edge of the marsh on the water side once elevated above tide, would furnish space for a wigwam. As Indians fed upon shell fish, the shells would accumulate and be spread out upon all sides. The fires lighted on the surface would leave charcoal, ashes, &c., which would in time be covered up by other layers of shells. During the exposure of the surface, the black earth would be produced by the decay of organic matter, and pieces of pottery and fragments of stone would be scattered through the whole, even the bird and fish bones are such as might be referred to an Indian feast. It has been objected, that the quantity of shells is so great that they could not be the result of human agency. But the quantity would be in proportion to the number of persons living on these spots, and the length of time they were occupied. Besides, this very quantity is far more difficult to account for upon any other supposition. The fossil beds that have been deposited along our coast, since the era of the present fauna, very rarely exceed 4 feet in thickness, yet here we have beds having a thickness of 20 feet. The theory that supposes the shells to be thrown up by the waves has not the slightest evidence in its support, that can be derived from the appearance of the beds that I examined. It is

impossible for loose shells to be thrown up by the waves without presenting intermixture of sand or mud, and without being in the slightest degree water-worn, to say nothing of the circular form of the shell banks; and then the existence of ashes, charcoal and Indian pottery had to be explained.

I next proceeded to examine the conditions under which the *Gnathodon* is found living at the present time. It is known that Mobile bay is the eastern limit of this genus, although I found one or two water-worn valves thrown up on Mullet Key on the coast of Florida, as Mr. CONRAD did before.

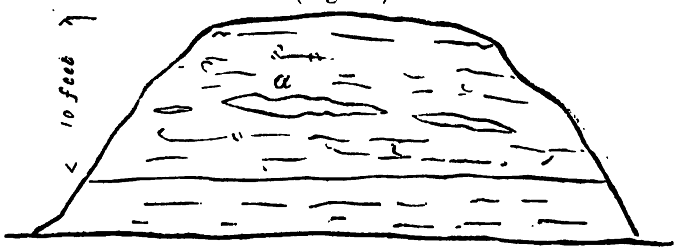
Below Choctaw Point light-house a very extensive flat is exposed at low water, composed of sand and mud; here great numbers of *Gnathodon* are buried two or three inches below the surface, and although *Cyrena* is not so abundant, yet still there was no difficulty in finding a large number of specimens. On the opposite side of the bay, at Mullet Point, these shells also occur in great numbers, many of them dead, but the shells of *Cyrena* exist in greater proportion than at Choctaw Point, and the dead shells of both are mingled together. At both places *Neritina* is found in vast numbers, with crowds of the little crab *Gelasimus vocans*, or fiddler.

Now how the waves could separate these shells, throwing up those of the *Gnathodon* alone and leaving the others behind, excepting a few individuals, has yet to be explained in addition to the other difficulties pointed out, before we can adopt the supposition that the Mobile Bay *Gnathodon* banks are natural deposits. Along the margin of the bay, between Point Clear and Mullet Point, I had abundant opportunity of examining other beds of a like character, but which are situated above tide level on the solid land. Oyster shells were most abundant here, because oysters are living not far from the place. With the surface of the beds sand was mingled, but on digging beyond the surface the interstices between the shells were empty with the exception of the usual black earthy substance. Fragments of Indian pottery were also collected on the surface. I have thought it proper to set

down my own observations on these beds, and the conclusions at which I have arrived, whilst means of observation by others yet remain. The beds are fast disappearing, vast quantities being annually removed for the construction and repairs of roadways. It is true that I have not examined all the deposits of this description, but I believe that those that I did examine were considered good types of all the rest.

Figure 29 represents a section of one of these beds.

(Fig. 29.)



(*a*) Ashes, burned shells, and charcoal, extending across the section.

There are in various parts of the State banks similar to these, in which, although the shells are different, the general characteristics are the same. At Fort Williams, on the banks of the Coosa, a bed was examined composed of shells of the genus *Unio*, with *Paludina magnifica*, shells that are abundant in the river, but accompanied by several species of *Melania* in great numbers. Only the large *P. magnifica* was selected. Pottery, black earth, ashes, arrow points, and human bones, were found here. Another bed occurs at Whitesburg on the Tennessee, consisting of shells of *Unio* with fragments of pottery.

But the most extensive bank of this sort that I have seen occurs at the head of the canal on Muscle Shoals; it is about 200 feet long, 100 feet wide, and 12 thick. It is situated on a high point that is never inundated by the river; the shells are *Unio* and our largest *Paludina*, *P. ponderosa*, and no others. Wherever univalves occur, they are always of the largest species.

Chapter Seventh.

Physical Features of Alabama.

Alabama lies between the parallels of 35 deg. and 30 deg. 16 min. North latitude, and the centre of the State is about 10 deg. West of Washington.

MEAN ANNUAL TEMPERATURE.

In the absence of any series of meteorological observations, I have attempted to deduce the mean annual temperature from that of the deep-seated springs of the State. In North Alabama, where such springs are abundant, I determined the temperature of the following:

DATE.	TEMP. OF AIR.	TEMP. OF SPRING.	NAME OF SPRING.
July.	80°.6	55°.4	Monte Sano, Madison Co.
June.	95°.	57°.6	Marmion, Limestone Co.
"	66°.2	58°.1	Evett's, Franklin Co.
"	68°.	58°.55	Opposite factory on Cypress creek, near Florence.
"	71°.6	59°.	Bran Dance spring, Lauderdale Co.
"	75°.2	59°.	Hart's sp. Bluff creek, Lauderdale Co.
"	89°.6	59°.	Lansford's spring, Lauderdale Co.
"	80°.6	59°.35	Spring near Cypress creek branch.
"	93°.	59°.4	Town spring, Athens, Limestone Co.
"	74°.2	59°.8	Franklin sp., under mt. Franklin Co.
"	95°.	59°.8	Simpson's spring, Lauderdale Co.
"	80°.6	59°.8	Bold sp., near Todd's sp., "
"	75°.	60°.5	Great spring at Tuscumbia.
"	80°.6	60°.8	Great spring at Huntsville.
"	80°.6	61°.6	Spring near Todd's, Lauderdale Co.
"	69°.8	61°.6	Johnson's furnace, near Athens.
"		61°.6	Capt. N. Davis', Limestone Co.

Leaving out the spring near the top of Montesano, which is elevated above the general level 800 feet, and taking the mean of the other sixteen springs, we have 59°.7 for the mean annual temperature of North Alabama, including the valley of the Tennessee.

The wells of Tuskaloosa are sunk in the strata of loose sand, pebbles, and red loam, that underlie the city; their depth rarely exceeds 20 yards. The following table shows the temperature of some of the wells of the city.

DATE.	TEMP. OF AIR.	TEMP. OF WELLS.	DEPTH IN FT.	NAME OF SPRING.
Sept. 5.	95°.	67°.55		Diocesan Female School.
"	95°.	67°.55		Mr. Foster's well.
"	95°.	68°.00	54	Pub. well op. Indian Queen.
	86°.	69°.35	60	Pub. well op. Washing'n Hall.
	75°.2	68°.90	66	Public well.
	75°.2	68°.00	60	Public well.
	75°.2	66° 20	57	Gov. Martin's.
	75°.2	66°.20	54	Mr. Cummings'.
	73°.4	66°.2	54	Dr. Garland's.
	73°.4	66°.65	63	Judge Ormond's.

The mean of the temperature of these 10 wells is 67°.46.

There are some springs, however, that flow from the strata perforated by these wells, where the edges outcrop along the bluffs of the Warrior, that have a lower temperature, as will appear from the annexed table. The temperatures were taken at two different seasons, and I have only used those that showed but little variation.

Temperature of springs in the vicinity of Tuskaloosa:

DATE	TEM. OF AIR. °	TEM. OF SPR'GS. °	DATE	TEM. OF AIR. °	TEM. OF SPR'GS. °	NAME OF SPRING.
M'ch	70.12	62.6	Dec.	30.2	62.6	University Spring.
"	70.12	62.6	"	33.8	62.6	" "
"	75.2	60.96	"	28.0	60.8	Judge Moore's.
"	69.8	62.6	"	32.	62.6	Meek's spring.
"	69.8	64.04	"	28.4	63.5	Clarke's spring.

There is a remarkable degree of uniformity in the temperature of these springs; considering the difference in atmospheric temperatures at the times they were examined, they may be considered as scarcely affected by atmospheric changes. If we take the mean of these, which perhaps will be nearer the truth, we shall have for the mean annual temperature of Tuskaloosa 62°.49. The mean annual temperature of Mobile is about 66°.

Supposing all these to be correct determinations, we have for the most elevated point in the State, where observations have been made, the mean annual temperature—

Montesano..54°.5
And for
Valley of the Tennessee........................59.7
Tuskaloosa..62.49
Mobile..66.

MOUNTAINS AND TABLE LANDS.

The highest points in the State are, doubtless, the spurs of the Cumberland mountains that enter the State from the Northeast. I have not yet ascertained the height of the mountains in Jackson, nor those in DeKalb, but they cannot greatly differ from that of Montesano, which, according to the recent railroad surveys, is 1565 feet above tide. Narrow ridges, divided by streams, run down towards the Tennessee, and retain their elevation so

long as the cap of mill-stone grit remains unbroken on their tops. When that is removed they rapidly sink to the level of the valley.

One of these extends to the river at Whitesburg, and another may be traced the whole distance from Claysville, opposite Gunter's landing, to the northern boundary of the State. Still farther to the east the ridges are shorter, the vallies narrower, and the streams smaller, as they approach the great mass of the Cum berland mountains.

The Tennessee finds a passage through an anticlinal valley, separating the Cumberland mountains from the Alleghanies, for they seem to converge at this point. The magnificent ridge on the east of the river constitutes, the eastern part the Lookout mountain which terminates in a bold precipice at the Village Springs, and the western side the Raccoon mountain which falls off gradually into the Warrior coal field. These mountains are separated by Murphree's valley at the southern extremity, and by the valley of Wills' creek the rest of their length. The Lookout mountain, seen from the valley of the Coosa, has a fine imposing appearance, and when length as well as height is taken into the account, it constitutes the only mountain range in the State.

The tops of these mountains form a plain 10 or 12 miles in breadth, unbroken, excepting by the narrow valley of Wills' creek. On most of the mountains in Madison little areas of table land of this description are found on the top, and many of the ridges in Jackson are capped in a similar manner, with a thick stratum of sandstone, which gives rise to this remarkable feature in our mountains.

On the south side of the Tennessee valley the area of drainage is limited by what appears to be a ridge, but what in reality is the edge of the lower beds of the coal measures and mill stone grit, for they do not thin out, but are broken abruptly off; they once extended across the valley, as their outliers on the tops of the mountains fully attest. This escarpment extends across

the State from Browns' Valley to the Mississippi line on the west and forms the water shed between the streams that flow South into the Warrior, and those that run into the Tennessee.

The country falls off rapidly from this escarpment towards the North, and a long but broken terrace occurs, which is best seen between Russel's valley and La Grange. This terrace is composed of the lower stratum of sandstone, and forms the Tennessee valley proper; it is found extending eastwardly to Summerville.

This stratum is again removed in Russel's valley, the underlying limestones are brought to view, and Bear creek with its tributaries, like the Tennessee, is obliged to seek an outlet towards the West.

The topography of our State map is so defective that many prominent features are not at all represented on it. Parallel with the Lookout mountain in Turkey Town valley, or what I prefer calling the Coosa valley, there is a prominent ridge, to which the name Red mountain was first applied about Elyton, from its great characteristic, the bed of red hematite which it contains. Along the whole valley from Pratt's Ferry in Bibb, to Yellow Creek in Cherokee, this ridge is found running parallel with the mill-stone grit escarpments; sometimes it is not at all prominent, but sinks to the general level of the country, and again rises—into what is called in Alabama a mountain. Near where Canoe creek cuts across the valley it is pretty high, as it is also at Greensport. On the west side of the Coosa ridges of considerable elevation occur in both Benton and Cherokee counties, following in direction the strike of the rocks, but they have not yet been sufficiently examined to enable me to give a particular description of them.

Extending across the State below the verge of the cretaceous rocks, an elevated tract of country is found from Choctaw through Clarke and Monroe counties, and how much farther West I am unable yet to say. This elevated range results from the slightly destructible character of the tertiary rocks com-

pared with those of the cretaceous system immediately North of them.

Near Tallahatta creek the rocks are siliceous; the highest hills, near Suggsville, are white soft limestone, as is also the case with the prominent points in Monroe.

It is a fact that would scarcely have been expected, that Choctaw Corner should be 172 feet higher than Tuskaloosa, and nearly as high as the bed of the Tennessee at Tuscumbia.

On the North the calcareous rocks of the cretaceous formation are bounded by a similar ridge, as may be seen at Springville, North of Eutaw, the hills North of Greensboro', and on the banks of the Tallapoosa, North of Montgomery, so that the prairie region of the State lies in a trough-like depression extending across from East to West, relieved by the occasional occurrence of low sand hills that cover up and hide from view the underlying rotten limestone.

VALLIES.

The strict relation that exists between the elevated portions of the country and geological structure is sufficiently obvious, and the same relations are also seen in the other great topographical features. The valley through which the Tennessee enters the State is part of an anticlinal valley, as I have just stated, which extends in a southwesterly direction to Blount springs. The course of the river as far as Gunter's Landing is consequently that of the strike of the rocks, but at that part the river is suddenly deflected towards the West. This portion of the valley is, as I have already stated, bounded by the Raccoon mountain and on the West by a long ridge extending through Jackson county, the intermediate space being 5 or 6 miles across. Towards the West, the moment the river leaves the anticlinal valley, the latter becomes more irregular; at Gunter's Landing it is narrow, after which it spreads out first on one side and then on the other, varying in breadth at the bottom from 1 to 10 miles, as the lower

stratum of sand stone recedes from or encroaches upon the valley on the South, or the spurs of chert on the North. Perhaps the widest point is that between La Grange and Wetumpka.

Of the numerous little vallies opening into that of the Tennessee from the North I shall say nothing, as I shall take up the subject again.

I mentioned Brown's valley and its continuation to Blount springs as part of that through which the Tennessee river flows, and although the carboniferous limestone and mill-stone grit are pushed up into prominent ridges on each side of this part of the valley, the valley itself is more elevated than the general level of the country on the West. It divides the two branches of the Warrior.

Parallel with this, and in other respects similar to it, is Murphree's valley. It differs, however, from the preceding in being deeper. In that only the upper strata of the silurian rocks are exposed, here the rocks of the red mountain group are brought to the surface.

Murphree's valley is the head of that long anticlinal valley which extends to Centreville, and which separates the Warrior and Cahawba coal fields. It is a curious fact, but one that is not uncommon with anticlinal vallies, that this valley forms the water shed, for a distance of 100 miles, of the region which it intersects.

What I have called the valley of the Coosa opens into this in a narrow gorge at the Village springs, having on one side the southern termination of the Lookout mountain, and on the other the Cedar mountain, the highest point of a long ridge that separates the valley nearly to Elyton.

The Coosa valley I have described with sufficient detail for my present purpose, when speaking of the mountains of the State. There are, besides these, other vallies, the description of which must be reserved for another occasion, excepting so far as it may appear in the notice of the rivers of the State.

THE RIVERS OF ALABAMA.

Every one who has examined a map of the United States must have been struck with the apparently anomalous direction of the Tennessee River, when compared with the great hydrographic systems of the United States. The great Atlantic slope, with its greatest elevation along the Blue ridge, has its system of rivers flowing directly towards the Atlantic. In Georgia and Alabama, which are beyond the South Western edge of this slope, where its inclination is no longer felt, the rivers flow South into the Gulf of Mexico. On the West, the Alleghanies constitute the summit of the slope, down which the rivers flow into the basin of the Mississippi. But the Tennessee after draining the valley between the Alleghanies and Cumberland mountains, at the southern termination of the latter, turns abruptly west, and then passes directly north through two degrees of latitude before it mingles with the great Father of Waters. I mentioned that the valley through which the Tennessee enters Alabama, is much lower than the continuation of that valley towards the South; it was therefore impossible for the river to pursue that course further; the crest of the ridge too, on the South of the valley, is 600 feet above the bed of the river. The valley from Gunter's landing is one of denudation, that is. one scooped out in the horizontal strata of the carboniferous rocks. How long the waters covered the region now occupied by this valley, before the river found its present outlet, it is impossible to say; for I have, as yet, found no fresh water deposits anywhere in the valley. It may be that the terraces observed on the mountain sides in Madison, as well as on the south side, may have been produced during the scooping out of the valley. At all events, the river at length found it easier to excavate a channel to the Mississippi through the yielding cretaceous rocks of Tennessee, than to pursue its direct course South to the Gulf. From Gunter's landing West, the channel lies in the limestone, but in its descent it comes to the lower cherty rocks at the head

of the Muscle Shoals, and continues to pour its waters over these strata in a series of cascades, for 15 miles, in which distance it falls 85 feet. The obstructions below Florence consist, I believe, of occasional bars composed of gravel where the river is wide.

The rivers that form the Coosa rise in the basin between the southern extremities of the Blue Ridge and Alleghanies, in Georgia. The Blue Ridge, as if determined not to sink down at once into obscurity, has left a noble monument in that remarkable knob, the Stone Mountain. Coosa, from its rise to Greensport in Cherokee county, flows along the strike of the rocks, and in a valley between the strata; it meets with scarcely any obstruction, and hence the remarkable phenomenon which it presents of a river ravigable for steamboats at both extremities, with the intermediate part an impracticable rapid. It will be seen that between the places just named, the course of the river is North-east and South-west; at Greensport it turns directly South, and consequently crosses the edge of the strata, so that where these are hard and indestructible rapids occur, but where limestone strata are crossed a level reach is found. This state of things continues for a distance of 180 miles to Wetumpka, where the mica slates of the metamorphic rocks form the first obstruction and head of navigation.

The navigation of a river 180 miles in length passing through such a country as that through which the Coosa passes, appears to me so important a matter in connection with the prosperity of the State, that its improvement should enter into any scheme of internal improvement devised for its best interests. There are no formidable obstructions, but such as arise from sudden bends and accumulations of gravel, that a judicious expenditure of a few thousand dollars would not readily obviate.

Between Wetumpka and the mouth of the Tallapoosa, the Coosa is a beautiful river, with high banks and deep water. At the junction, an accumulation of gravel takes place, which is the result of the lessening suddenly of the transporting force of the two rivers, by which the materials rolled onward by the streams

are arrested in their progress, producing a bar and serious obstruction to navigation, which can only be remedied by the removal of the cause, that is, by making the streams to come together at a more favorable angle. The obstructions below this, are such as are common to all our rivers below the falls, resulting from abrupt bends, sudden widening, submerged logs, overhanging timber, &c.

It will be seen at a glance on the map how completely the upper Warrior conforms to the Warrior coal field. Rising on the verge of the Tennessee, it runs rapidly over the coal measures of the basin, which it drains. The fall of the Warrior between its source and Tuskaloosa is nearly 1000 feet, or 5 feet in a mile, and between the latter place and Mobile the rivers that unite with the Warrior have a fall of only 161 feet, or 5 inches a mile. It is for this reason that the Warrior rises during floods to the height of 50 feet at Tuskaloosa; the water being suddenly checked and unable to escape with the rapidity of the rest of its course it accumulates as it reaches Tuskaloosa.

The obstructions in this river below the falls, and indeed in all the rivers that flow over the greatly inclined cretaceous and tertiary plane of the State, arise from deposits of gravel, sand, &c., that the river is no longer able to push forward. I am inclined to think that our rivers have become almost permanent, for certainly all the bars that I have observed between Tuskaloosa and Demopolis have not changed their form for years. From the yielding nature of the banks, such streams are subject to deflections, producing sudden bends that become serious obstructions.

The great quantity of submerged timber is the result of the overflowing of the land by freshets and the floating away of fallen trees; this, too, must have greatly diminished, and must still continue to diminish.

The convergence of the Alabama towards the Tombigby, is the result of that dynamical law, "a body in motion will follow the line of least resistance." The former stream flows along

the loose sandy strata that underlie the rotten limestone, until it reaches a low point in that stratum, through which it passes to unite with the Tombigby and form the Mobile River.

The rivers of Alabama, whether we consider them as one of the great physical features of the State, or in an economical point of view, are exceedingly interesting. There is scarcely any extensive and really valuable agricultural tract in the State that has not its navigable stream.

[At least one additional chapter, "on the results of the Geological Survey in their application to Agriculture," was included in the design of Professor TUOMEY's Report, but of this no M. S. has been found.]

APPENDIX No. 1.

REPORT OF CHEMICAL DEPARTMENT

OF THE

GEOLOGICAL SURVEY,

FOR THE YEAR 1855.

TO PROFESSOR M. TUOMEY,

State Geologist Alabama.

SIR:

In the following Report, I beg to lay before you the results obtained in the Chemical Department of the Geological Survey, during the past year.

Very respectfully,

Your obedient servant,

J. W. MALLET.

Univ. of Ala., Dec. 1855.

REPORT.

Among the mineral substances furnished by Alabama, specimens of which it seemed desirable to submit to chemical examination, five principal groups presented themselves, namely: coals, iron ores, limestones, soils, and mineral waters.

And of these the limestones were first examined, since the very great extent to which this class of rocks occurs in the State, and their value in the preparation of lime, the smelting of iron, and in agriculture, render a knowledge of the chemical composition of specimens from different localities, and suited to different purposes, of immediate practical importance. The following results were obtained, on the analysis of a series of specimens which are classified by their chemical composition, geological relations, similarity in physical properties, and adaptation to practical use—the numbers prefixed to the analyses refer to the Laboratory note-book, and to the labels of specimens preserved in the Cabinet of the Survey.*

METAMORPHIC AND SILURIAN LIMESTONES.

No. 1. A very beautiful, snow-white marble, of fine close grain, and presenting the hardness and fracture of finely crystal-

*Methods of Analysis Pursued.—Regarding it as much more important to obtain really accurate results for a small number of specimens than rough approximations for a great many, I have throughout adopted the best published methods, even where so doing required more time and labor than are usually devoted to analyses of this kind. In but one or two instances has recourse been had to analysis by measure, except for the determination of small quantities of iron, by means of per-manganate of potash.

line pure carbonate lime. Sp. gr.=2.712. Dissolved very readily in muriatic acid:

Analysis gave—

Carbonate lime	99.47
Carbonate magnesia	.38
Silica	trace.
	99.85

LOCALITY: *Herd's upper quarry, Talladega county.*

No. 6. A marble of a pale but pretty rose tint, nearly as close-grained as No. 1., but in mass much softer, and slightly greasy to the touch like many minerals rich in magnesia. Sp. gr.=2.761. Effervesced pretty readily with muriatic acid at first, but the action of the acid soon became slow, and a large amount of insoluble matter was left:

Analysis gave—

Carbonate lime	35.67
Carbonate magnesia	2.51
Alumina, (with trace of oxide iron)	.39
Insol. matter	61.15
	99.72.

In order further to examine the portion insoluble in muriatic acid, which was ascertained to be a silicate, it was fluxed with carbonate of soda, and the analysis proceeded with by the method usual for such substances.

It was found to contain in 100 parts:

		Atoms.	
Silica	63.67	1.406	5.6
Magnesia	30.24	1.512	6.
Alumina	2.05		
Peroxide iron	.39		
Lime	trace.		
Oxide manganese	trace.		
Water	3.34	.371	1.5
	99.69.		

and therefore proved to be a Talc or Steatite. Its sp. gr.=2.626. The marble is an intimate mixture of finely crystalline carbonate lime with this talcose mineral, the latter being diffused with tolerable uniformity through the mass, though a separate experiment upon a larger quantity of the marble gave but 45.52 p. c. of mineral insol. in muriatic acid.

LOCALITY: *Colquitt's quarry, Talladega county.*

No. 13. A perfectly compact marble, of a greyish color, breaking with rather a sharp splintery fracture. Sp. gr.=2.711. Readily soluble in muriatic acid:

Analysis—

Carbonate lime	96.22
Carbonate magnesia	.66
Peroxide iron* and alumina	.20
Insol. (siliceous) matter	2.79
	99.87

LOCALITY: *Pratt's Ferry, Cahawba river.*

*The small quantity of iron found in these limestones is set down as peroxide, although in some cases the metal very probably exists as protocarbonate.

No 14. A greyish limestone somewhat resembling the last, but not quite so uniform and compact, intersected by little veins of crystalline carbonate lime. Sp. gr.=2.717. Dissolved readily and rapidly in muriatic acid:

Analysis—

Carbonate lime	96.37
Carbonate magnesia	1.72
Peroxide iron and alumina	.25
Insoluble (siliceous)	1.04
	99.38

LOCALITY: *Hardy Clement's Mill, Big Sandy creek.*

No. 4. A dark-grey, rather fine-grained crystalline limestone, uniform, of easy fracture, and strongly fœtid when broken, giving off the odor rather of phosphuretted than of sulphuretted hydrogen. Sp. gr.=2.698. Dissolved very readily in muriatic acid:

Analysis—

Carbonate lime	90.43
Carbonate magnesia	4.28
Peroxide iron (with trace of alumina)	.74
Insoluble (siliceous clay)	4.30
Phosphoric acid	trace.
Carbonaceous matter	trace.
	99.75

LOCALITY: *Bees-wax creek, near Columbiana, Shelby county.*

No. 5. A compact limestone, darker in color than the last, and shewing a tendency to produce plane surfaces on fracture; contains veins of white crystallized carbonate lime. Sp. gr.=2.717. Dissolves readily in muriatic acid:

Analysis—

Carbonate lime	90.52
Carbonate magnesia	4.93
Peroxide iron and alumina	.49
Insol. (siliceous clay)	4.35
Carbonaceous matter	trace.
	100.29

LOCALITY: *Beeswax creek, near Columbiana, Shelby county.*

The above mentioned specimens are, with the exception of No. 6., essentially carbonate of lime. The first, (No. 1.) is very valuable as a marble, and No. 13 might very well be employed as a handsome building stone, while from No. 6 small ornaments, not likely to be exposed to much violence, could be very readily cut. The other limestones are well adapted for burning into excellent lime.

No. 51. A moderately fine-grained crystalline limestone of a pure white color, very slightly tinged in spots by peroxide iron, more opaque than No. 1, slightly fœtid when broken. Sp. gr.=2.846. Dissolved slowly in muriatic acid:

Analysis—

Carbonate lime	55.48
Carbonate magnesia	44.04
Peroxide iron and alumina	.31
Insol. (quartz)	.09
	99.92

LOCALITY: *Colquitt's quarry, Talladega county.*

No. 7. A white marble, very like No. 51; a little coarser in grain, the crystalline facets being larger. Sp. gr.=2.855. Dissolved slowly in muriatic acid:

Analysis—

Carbonate lime	55.42
Carbonate magnesia	43.95
Peroxide iron and alumina	.19
Insol. (minute scales of mica)	.40
	99.96

LOCALITY: *Yonge's quarries, Macon county.*

No. 8. A close-grained crystalline limestone; white, with a slight tinge of yellow, very uniform in texture. Sp. gr.=2.865. Slowly soluble in muriatic acid:

Analysis—

Carbonate lime	55.07
Carbonate magnesia	42.94
Peroxide iron and alumina	.25
Insol. (mica scales)	1.39
	99.65

LOCALITY: *Yonge's quarries, Basin plantation, Macon county.*

No. 2. A white crystalline limestone, close grained, but not quite so uniform as Nos. 7. and 8; the white color not so pure as that of No. 7. Sp. gr.=2.833. Dissolved slowly in muriatic acid:

Analysis—

Carbonate lime	54.57
Carbonate magnesia	37.93
Peroxide iron	2.24
Silica and scales of mica	5.05
	99.79

The iron probably exists as proto-carbonate.

LOCALITY: *Reese's quarries, above Echol's mills, near Auburn, Macon county.*

No. 52. A fine granular, almost compact limestone of greyish white tint, not so uniform as preceding specimens, some portions being more compact than others and yellowish; contains small joints, in the direction of which the rock breaks most readily, and the surfaces of which are lined with minute scales of mica. Sp. gr.=2.860. Dissolves gradually in muriatic acid:

Analysis—

Carbonate lime	59.33
Carbonate magnesia	38.39
Peroxide iron and alumina	.33
Insol. (quartz, and mica scales)	1.81
	99.86

LOCALITY: *Reese's quarries, above Echol's mills, 4 miles from Auburn, Macon county.*

No. 3. A fine-grained greyish limestone, not quite uniform in tint, and intersected by small veins of white carbonate of lime. Sp. gr.=2.845. Dissolved slowly in muriatic acid:

Analysis—

Carbonate lime	56.07
Carbonate magnesia	41.84
Peroxide iron, (with trace of alumina)	1.04
Insoluble (silica with scales of mica)	1.64
	100.59

LOCALITY: *Echol's mills, Macon county.*

No. 9. A fine, close-grained and uniform limestone of blue-grey color. Sp. gr.=2.844. Dissolved slowly in acid:

Analysis—

Carbonate lime	55.16
Carbonate magnesia	44.22
Peroxide iron	.44
Insol. (quartz, and mica scales)	.79
	100.61

LOCALITY: *Yonge's quarries, Macon county.*

No. 10. A dense, moderately fine-grained, and uniform limestone of dingy brownish-white color; harsh to the touch, like No. 51. Sp. gr.=2.793. Dissolved slowly in muriatic acid:

Analysis—

Carbonate lime	56.68
Carbonate magnesia	40.25
Peroxide iron and alumina	.44
Insol. (siliceous)	2.49
	99.86

LOCALITY: *Jones' Valley.*

No. 11. Resembles in appearance many specimens of "rotten" or "prairie" limestone, but is quite hard and compact; of a dingy, brownish-white color—no appearance of crystalline structure. Sp. gr.=2.617. Effervesced at first with acid more briskly than No. 10, and dissolved gradually:

Analysis—

Carbonate lime	54.62
Carbonate magnesia	40.13
Peroxide iron and alumina	.80
Carbonaceous matter	trace.
Siliceous clay	4.64
	100.19

LOCALITY: *Jones' Valley.*

No. 12. Very finely crystalline, nearly compact, of a yellowish-grey color, not uniform, but tinged in places by peroxide iron, and containing little veins and geodes of crystallized carbonate lime. Sp. gr.=2.853. Dissolved more slowly in muriatic acid than either No. 10, or No. 11:

Analysis—

Carbonate lime	55.17
Carbonate magnesia	43.39
Peroxide iron	.89
Silica (with oxide iron)	.45
	99.90

LOCALITY: *Chockolocko, near Boiling Springs.*

No. 15. Bluish-grey, compact limestone, presenting distinct bedding planes; hard, and breaking with conchoidal fracture. Sp. gr.=2.828. Dissolved slowly in acid. The considerable amount of insoluble matter left was fluxed with carbonate of soda, and separately analysed:

Analysis—

Carbonate lime		49.22
Carbonate magnesia		37.41
Peroxide iron (with trace of alumina)		.85
Sol. in muriatic acid		87.48
Silica	12.50	
Alumina	.37	
Peroxide iron	.17	
Lime	trace.	
Insol. in muriatic acid		13.04
		100.52

LOCALITY: *Talladega, (Dr. McKensie's.)*

24

No. 53. A dark bluish-grey compact limestone; hard, and breaking with indistinct conchoidal fracture; yellowish on weathered surfaces. Sp. gr.=2.847. Gradually dissolves in muriatic acid:

Analysis—

Carbonate lime	51.48
Carbonate magnesia	34.32
Carbonate protoxide iron	3.05
Alumina	.47
Carbonaceous matter	trace.
Insol. (siliceous, contains alumina and iron)	10.55
	99.87

LOCALITY: *Snow's, near Oxford.*

The last twelve specimens are dolomites or magnesian limestones, and present great uniformity of composition; most of them approaching with remarkable closeness to the normal compound of one atom carbonate of lime, with one atom carbonate of magnesia, which gives in 100 parts—

Carbonate lime	54.35
Carbonate magnesia	45.65

They are good building stones, Nos. 7, 8, 9, 10 and 51, furnishing material for handsome structures. They will also yield good lime on burning, but this lime will not be very "fat" or solidify very quickly with water, owing to the large proportion of magnesia mixed with it. No. 15 will furnish a poor hydraulic lime.

All the limestones above mentioned are from the older (metamorphic and silurian) rocks.

CARBONIFEROUS LIMESTONES.

The following specimens have been examined:

No. 54. A rather dark greyish-brown limestone, of crystalline structure, not very uniform, containing little veins of white crystallized carbonate lime, and also quartz grains distinctly visible. One surface of the specimen had a number of pentremites projecting from it, one or two of which were included in the portion pulverized for analysis. Slightly fœtid when broken. Sp. gr.=2.676. Dissolves readily in muriatic acid:

Analysis—

Carbonate lime		64.03
Carbonate magnesia		1.76
Carbonate protoxide iron		2.03
Alumina		trace.
Phosphoric acid		trace.
Insol.	Fine siliceous clay	11.86
	Quartz grains	20.05
		99.73

LOCALITY: *Huntsville.*

No. 55. Very fine granular limestone; bluish-grey; uniform. Sp. gr.=2.702. Dissolves easily in muriatic acid:

Analysis—

Carbonate lime	92.17
Carbonate magnesia	.61
Carbonate protoxide iron	.97
Alumina	.32
Phosphoric acid	trace.
Insol. (siliceous clay)	5.57
	99.64

LOCALITY: *Ditto's Landing, Tennessee River.*

No. 56. A yellowish or cream-colored limestone, consisting of minute rounded granules, among which a few little crystalline facets of carbonate of lime could be distinguished on close examination. The general appearance of the stone is strikingly like that of English "oolite." Sp. gr.=2.592. Dissolves easily in muriatic acid:

Analysis—

Carbonate lime	99.21
Carbonate magnesia	.39
Peroxide iron	trace.
Insol. matter	.30
	99.90

LOCALITY: *Russell's Valley, Franklin county.*

No. 58. A stone made up of a mass of stems of encrinites; consisting of coarsely crystalline carbonate lime, nearly pure and white, and of a dingy greenish smoke-colored portion, the latter apparently containing but little lime. Sp. gr.=2.641. Disolves quickly in muriatic acid:

Analysis—

Carbonate lime	54.25
Carbonate magnesia	.34
Alumina	.24
Peroxide iron	1.21
Phosphoric acid	trace.
Insol. (quartz and fine siliceous clay)	43.44
	99.48

LOCALITY: *Bed of Maple creek, above Athens, North Ala.* (The specimen is from the surface, and perhaps does not fairly represent the bed.)

No. 59. A fine-granular mineral of smoke-gray color, with parts of a greenish tinge; contains bones of fossil fish, can scarcely be considered as a limestone from its small content of carbonate of lime. Effervesces readily with muriatic acid:

Analysis—

Carbonate lime		16.41
Carbonate magnesia		trace.
Phosphoric acid........ 6.31		
Lime 7.88	*=3 Ca O, PO_5	14.19
Fluorine..............trace		
Peroxide iron		.36
Alumina		trace.
Soluble silica		.44
Insol. { Quartz, greenish slaty mineral, siliceous clay, and traces of mica and iron pyrites }		68.28
		99.68

LOCALITY: *Cow-pens creek, North Ala.*

Of the above limestones of carboniferous age, Nos. 53 and 56 will afford good rich lime on burning, and Nos. 54 and 58 might perhaps be picked so as to afford lime also, but are not well adapted to its preparation, as containing a large percentage of siliceous matter. No. 59, which can scarcely be called a limestone, and is of little value on account of the carbonate of lime which it contains, would prove, if obtainable in quantity, of importance in agriculture, from the large amount of phosphoric acid existing in it as phosphate of lime—one of the most valuable and costly manures.

* 6.31 of phosphoric acid, by calculation, should be united with 7.46 of lime to form 3 Ca O, PO_5

LIMESTONES OF THE CRETACEOUS FORMATION.

No. 57. A highly fossiliferous rock, made up of shells and their fragments—of a slight yellowish tinge. The interior of many of the shells appeared to be filled with nearly pure quartz sand, in which spangles of mica were visible; the shells themselves were frequently converted into crystalline carbonate of lime. Dissolved quickly in muriatic acid:

Analysis—

Carbonate lime	53.66
Carbonate magnesia	.97
Alumina	.27
Peroxide iron	.22
Insoluble (quartz sand, scales of mica, and a little finely divided siliceous matter)	44.60
	99.72

LOCALITY: *Chunnennugga Ridge, Macon County.*

No. 60. Also highly fossiliferous; the shells for the most part white crystalline carbonate of lime; the limestone cementing them together of a light brownish grey color. Contains numerous small cavities, often lined with carbonate lime. Readily soluble.

Analysis—

Carbonate lime	88.82
Carbonate magnesia	2.18
Peroxide iron and alumina	.94
Phosphoric acid	.23
Insoluble (quartz sand and siliceous clay)	7.20
	99.37

LOCALITY: *Chunnennugga Ridge, Macon County.*

No. 61. Also fossiliferous, but more compact and uniform than the preceding two specimens; of a light grey tint, with scales of mica pretty uniformly distributed through the mass. Sp. gr.=2.649. Acted on quickly by acid:

Analysis—

Carbonate lime	46.96
Carbonate magnesia	1.19
Peroxide of iron (with trace of alumina)	.78
Phosphoric acid	.26
Insoluble (quartz sand, mica scales, and a little fine siliceous matter)	50.61
	99.80

LOCALITY: *Chunnennugga Ridge, Macon County.*

No. 62. A dark grey limestone of uniform appearance, with numerous little specks of mica visible upon the surface, of close and compact texture. Sp. gr.=2.611. Dissolved quickly by muriatic acid.

Analysis—

Carbonate lime	51.92
Carbonate magnesia	.61
Peroxide iron and alumina	1.60
Potash	traces.
Insoluble (quartz sand, mica scales, and siliceous clay,	45.71
	99.84

LOCALITY: *Mr. Crawford's,* 10 *miles North of Chunnennugga Ridge, Macon County.*

No. 16. Rotten or prairie limestone, presenting the usual appearance of this deposit; a light gray or dingy white mineral of

about the same consistence and hardness with hard English chalk. Sp. gr.=1.976.* Muriatic acid acts rapidly upon it, dissolving out the carbonate of lime with brisk effervesence:

Analysis,

Soluble in muriatic acid—	
Carbonate lime	75.07
Carbonate magnesia	.72
Per-oxide iron	1.44
Alumina	.79
Phosphate lime (tribasic)	.4035
Silica	.14
Insoluble in muriatic acid.	
Silica	11.99
Alumina	3.38
Per-oxide iron	1.84
Lime	1.47
Potash	.0945
Water	2.49
	99.83

(The potash is placed among the constituents insoluble in muriatic acid, as supposed to exist in combination with silica.)

LOCALITY: *Demopolis.*

No. 18. Also "Rotten limestone." Closely resembled No. 16 in appearance; the specimen examined contained one or two fossil shells, [*inoceramus*,] sp. gr.=1.923.* Acted on by muriatic acid as preceding:

*No doubt too low a number, owing to the crumbling of this mineral in water. Many of the densities determined are too low for the solid mineral, as small cavities exist throughout the mass of many of the specimens.

Analysis.

Soluble in muriatic acid:

Carbonate lime	64.37
Carbonate magnesia	.79
Per-oxide iron	2.19
Alumina	.75
Phosphate lime	.5432
Silica	.059

Insoluble in muriatic acid.

Silica	19.58
Alumina	3.97
Per-oxide iron	2.49
Lime	.78
Magnesia	trace
Potash	.0410
Water	3.58
	99.14

LOCALITY: *Cahawba.*

No. 17. Another specimen of "Rotten Limestone;" like the last two specimens, but lighter in color, approaching white. Sp. gr. = 2.064.* Acted on by muriatic acid as preceding:

Analysis.

Soluble in muriatic acid:

Carbonate lime	80.48
Carbonate magnesia	.53
Per-oxide iron	1.24
Alumina	.98
Phosphate lime	.3710
Silica	.194

Insoluble in muriatic acid:

Silica	9.04
Alumina	2.19
Per-oxide iron	1.55

25

Lime	1.01
Potash	.1135
Water	2.22
	99.92

LOCALITY: *Jones' Bluff, Greene County.*

The preceding analyses of cretaceous limestones are interesting chiefly as regards the use which may be made of these minerals in agriculture. Particular attention was directed, on this account, to the presence of the alkalies, phosphoric acid, and soluble silica. Two specimens (Nos. 60 and 61) from Chunnenugga Ridge yielded about a fourth of one per cent of phosphoric acid, which would give the lime produced from these stones some value as a material to be applied to lands poor in this most important acid. The analyses of "Rotten Limestone" were made with much care, since the valuable nature of the constituents of this deposit is already practically proved by the fact that from the disintegration of "Rotten Limestone" are produced the richest prairie soils of the counties of Greene, Sumter, and Marengo, and in fact we find among the results of these analyses —phosphate of lime .37 to .54 per cent.—potash .04 to .11 per cent.—and silica in a condition readily soluble in dilute acids .06 to .19 per cent.

One of these "Rotten Limestones" possesses value on another account. No. 17, from Jones' Bluff, having been (in order to the determination of the alkali,) intensely ignited in a furnace, and therefore burnt into caustic lime, was found on mixture with water to harden under an excess of that fluid, and therefore had yielded a "hydraulic lime." The softness of this limestone, and the ease with which it may be obtained in vast quantity would make it a valuable material for hydraulic cement, the quality of which might, no doubt, be made very fair by the addition of some clay, grinding or crushing the lumps, and then burning.

TERTIARY LIMESTONES AND MARLS.

No. 63. A close compact rock of light brownish yellow color. Sp. gr. = 2.569. Dissolves quickly and easily in muriatic acid:

Analysis—

Carbonate lime	94.84
Carbonate magnesia	.96
Per-oxide iron	1.81
Alumina	.31
*Chlorine (chloride sodium?)	faint traces
Insoluble (ferruginous silica)	1.69
	99.61

LOCALITY: *Col. Darrington's, Clarke county.* (This is the rock which has received in the newspapers the name of "concrete limestone.")

No. 64. A soft friable limestone or marl of very light cream color, containing some fossil shells. Sp. gr. = 2.151. Dissolves quickly in muriatic acid.

Analysis—

Carbonate lime	94.85
Carbonate magnesia	1.57
Per-oxide iron	.27
Alumina	trace
Phosphoric acid	.31
Chloride sodium	trace
Insoluble (ferruginous silica)	2.44
	99.44

*Almost all the limestones and marls of the newer formations of the State yield, on careful examination, traces, sometimes very distinct, of a soluble chloride, nearly always chloride of sodium.

LOCALITY: *Clarke county.* (The "white limestone," so extensively used for building chimnies in the lower counties of the State.)

No. 65. A loosely aggregated mass, made up of shells (*orbitoides*) and their fragments—of a brownish-yellow color, arising from per-oxide iron. Readily soluble in muriatic acid:

Analysis—

Carbonate lime	93.19
Carbonate magnesia	1.09
Per-oxide iron	1.03
Alumina	.26
Potash	trace
Chloride (of sodium?)	trace
Insoluble (ferruginous silica)	4.15
	99.72

LOCALITY: *Clarke Co.*

The above three specimens, it will be observed, all contain a high per-centage of pure carbonate of lime, and will therefore prove useful for lime-burning, and agricultural purposes. From their loose state of aggregation they may be readily got out in quantity, and, if necessary, crushed to a coarse powder for application to the land. No. 64 also contains a considerable amount (.31 per cent.) of phosphoric acid, giving it additional value as a manure. The vicinity of these limestones to the river gives them an obvious advantage.

In connection with these limestones, themselves important in an agricultural point of view, may very well be considered the *greensand* of the cretaceous formation, which in New Jersey and other States has proved a most valuable manure, owing to

the large amount of *potash* which it contains, and which its ready decomposition in presence of air and moisture enables it rapidly to supply to the growing plant. Although the experiments upon Alabama greensand are not yet complete, yet sufficient has been done to show that it contains potash in considerable amount, and to determine the average per-centage of this alkali, and of other important constituents, in specimens of greensand marl from several localities. But one specimen of marl presented grains of the green mineral of sufficient size and purity to be picked out and separately analysed, so as to give the composition of the mineral itself unmixed with the other portions of the marl, and even these grains exhibited traces of commencing decomposition. From a second specimen some grains of much less purity were obtained, and separately analyzed, but the results in this latter case are not of very much value.

No. 66. Roundish, generally flattened, grains of a dark blackish-green color when pure, moderately soft, and easily broken or crushed. The grains undergoing decomposition were lighter in color, and many of them, especially those far advanced in decomposition, were found to be made up of very minute crystals of iron pyrites, highly lustrous, and under the microscope appearing as beautifully regular little octahedrons, held together by the whitish-green earthy residue of the grains. Sp. gr. of pure grains = 2.297. Acted on slowly by very strong boiling muriatic acid. The results of two analyses of grains picked as carefully as possible were as follows:

			MEAN.
Silica	57.83	57.28	57.56
Alumina	6.70	6.42	6.56
Protoxide iron	20·93	19.34	20.13
Lime	.91	1.18	1.04
Magnesia	1.35	2.05	1.70
Potash	4.81	4.95	4.88
Water	8.17	8.17	8.17
Iron pyrites	trace		
	100.70	99.39	100.04

A third analysis gave—

Silica	58.91	—(of which 11.85 insoluble in carbonate of soda.)
Alumina	5.48	
Protoxide iron	19.24	
Lime	.71	
Magnesia	.87	
Potash	4.58	
Water	8.17	
Iron pyrites	1.46	(=.78 per cent. of sulphur.)
	99.42	

The portion separated as silica, and found to be insoluble in carbonate of soda, consisted of quartz, insoluble silicates, &c.

LOCALITY: *Coal Bluff, Alabama River.*

No. 67. Grains of much less purity than the preceding—for the most part of a light apple-green color, often changed on the outside to a yellowish brown, due to the production of per-oxide of iron. Sp. gr. = 2.349. Acted on by strong muriatic acid still more slowly than No. 66.

Analysis—

Silica	58.74	—(of which 23.89 insoluble in carbonate of soda.)
Alumina	4·71	
Protoxide iron	21.06	—(traces as per-oxide,)
Lime	.92	
Magnesia	1.48	
Potash	3.26	
Water	9.79	
	99.96	

LOCALITY: *Gainesville* (?)

Of the following specimens of greensand marl, complete analyses were not made, but weighed portions of the specimens carefully mixed and pulverized, were digested in strong boiling

muriatic acid, and in the solution obtained the three substances to which the marls mainly owe their utility, namely potash, lime, and phosphoric acid, were tested for, and the amounts present carefully determined. As iron pyrites, when undergoing oxidation in a soil, very often proves most noxious to plants, it seemed desirable to ascertain also the amount of this mineral existing in each marl, although the bright and sharp edged little crystals here found seem very little disposed to oxidation in presence of air and moisture.

No. 68. Marl, from which No. 66 was selected, consisting of greensand grains, fine quartz sand, siliceous clay, fragments of shells, bones, shark's teeth, &c.:

Gave 1.673 per cent. of potash, 1.003 of phosphoric acid, 29.33 of carbonate of lime, from shells, &c., and 10.57 per cent. of minute crystals of iron pyrites.

LOCALITY: *Coal Bluff, Alabama River.*

No. 69. From which No. 67 was selected. Light green mass, stained brown in many places by per-oxide of iron, composed of greensand grains, quartz grains, and fragments of shells:

Gave for 100 parts, 2.437 of potash, .183 of phosphoric acid, .87 of carbonate of lime, and a mere trace of iron pyrites.

LOCALITY: *Gainesville* (?)

No. 70. A very loosely coherent mass consisting almost entirely of grains of quartz and of greensand, with a few small shells:

Gave, per cent., 2.213 of potash, a slight trace of phosphoric acid, .69 of lime, probably not as carbonate, and a trace of iron pyrites.

LOCALITY: *Gravel Creek, near Camden.*

No. 76. The preceding specimen contained the grains of greensand apparently unaltered by exposure, and of a dark blackish-green color. Another specimen therefore from the same place

was examined, in which the grains had all the yellowish-brown rust-color of per-oxide of iron, and which had obviously undergone extensive alteration. On heating in strong hydro-chloric acid the per-oxide of iron rapidly dissolved out, exposing many dark grains to view. The mass gave, in 100 parts, 1.893 of potash, a trace of phosphoric acid, .67 of lime, probably not as carbonate, and no iron pyrites.

LOCALITY: *Gravel Creek, near Camden.*

For the sake of comparison, I quote the following analysis, representing the average composition of the greensand grains of New Jersey:

Silica	50.99
Alumina	5.76
Protoxide iron	23.72
Lime	.43
Magnesia	.27
Potash	10.07
Water	8.43
	99.67

The only other earthy minerals which have been examined are two specimens of Kaolin or Porcelain clay, from which the following results were obtained, care being taken to separate the free and combined silica.

No. 34. A fine white clay of very uniform appearance, soft, and easily cut or scraped; marked with a few pinkish stains upon the outside of the mass.

Analysis—

		Atoms.	
Combined silica	39.75	.877	1.2
Free silica	4.85		
Alumina	38.92	.757	1.
Per-oxide iron	.78		
Lime, potash, &c.	1.03		
Water	13.38	1.487	2.
Undecomposed mineral	.90		
	99.61		

LOCALITY: *Green's, above Jacksonville.*

No. 78. A beautifully white and uniform clay, of rather more uneven fracture than No. 34. Soft and fine.

Analysis. (dried at 212°)—

		Atoms.	
Combined silica	19.85	.438	1.
Free silica	17.44		
Alumina	31.92	.621	1.4
Per-oxide iron	trace		
Potash, lime, and magnesia	.72		
Water	15.09	1.676	3.8
Undecomposed mineral	14.28—(of which 7.49 finely divided quartz.)		
	99.30		

LOCALITY: *About four miles Northeast of Louina, Randolph county.*

IRON ORES.

Of these a considerable number was examined so as to present a tolerably fair general view of the chemical nature of the ores occurring in the State. They are arranged in groups under the names of the particular mineral species.

MAGNETIC IRON ORE.

No. 25. Dark iron-black mass, made up of grains closely cohering, and among which a few particles of yellowish earthy matter were in places to be seen. Sp. gr. = 4.827. Magnetic, but not very strongly so—showed feeble polarity.

Analysis—

*	Per-oxide iron	61.37
	Sesquioxide titanium	9.21
	Protoxide iron	28.80
	Magnesia	.08
	Alumina	trace
	Silica	.54
		100.

Contains 65.36 per cent. of metallic iron.

LOCALITY: *Wm. Andrews', near Oak Bowery.*

RED HEMATITE.

No. 26. Very dense, compact, and hard, deep red mass, of very indistinct fibrous structure, containing numerous minute grains of quartz pretty uniformly diffused through it. Sp. gr. = 3.873.

*Calculated from 93.37 per cent. of Fe_2O_3 and 10.21 of TiO_2.

Analysis—

Per-oxide iron	76.87
Sesquioxide manganese	.51
Silica	20.74
Alumina	1.55
Phosphoric acid	trace
	99.67

Contains 53.81 per cent. of metallic iron.
LOCALITY: *Near Columbiana, Shelby County.*

No. 31. Fossiliferous iron ore, consisting of a mass of flattened globules, and impressions of small shells—dark cinnabar-red color. Sp. gr.=4.012.

Analysis—

Per-oxide iron	88.02
Silica	11.59
Alumina	.07
Lime	.05
Oxide manganese	trace
Phosphoric acid	.09
	99.82

Contains 61.61 per cent. of metallic iron.
LOCALITY: *Gaylesville.*

No. 27. Also fossiliferous—less compact, softer, and of lighter color than the last. Streak bright brick red, soiling the fingers. Sp. gr.=2.964.

Analysis—

Per-oxide iron	82.67
Sesqui-oxide manganese	.40
Silica	13.44

Alumina	3.09
Lime	trace
Phosphoric acid	.06
	99.66

Contains 57.87 per cent. of metallic iron.
LOCALITY: *Moore's.*

No. 33. Fossiliferous ore, containing a great number of flattened globules—dark reddish-brown on surface, with a slight tarnish. Sp. gr.=3.168.

Analysis—

Per-oxide iron	51.46
Silica	27.74
Carbonate lime	17.89
Alumina	2.32
Oxide manganese	.24
Phosphoric acid	.16
	99.81

Contains 36.02 per cent. of metallic iron.
LOCALITY: *Pierson's Mill, St. Clair County.*

No. 32. Also fossiliferous—grains much smaller, and fracture finer than in preceding specimens. Soiled the fingers slightly. Sp. gr.=3.230.

Analysis—

Per-oxide iron	61.87
Silica	37.58
Alumina	.26
Lime	.03
Sesquioxide manganese	.05
Phosphoric acid	.03
	99.82

Contains 43.31 per cent. of metallic iron.
LOCALITY: *David Hanby's, Blount County.*

BROWN HEMATITE.

No. 35. Pure brown hematite, of radiating, fibrous structure; the exterior surface of the botryoidal mass smooth and glazed. Sp. gr.=3.626.

Analysis—

Per-oxide iron	82.82
Sesquioxide manganese	.77
Lime	trace
Alumina	.35
Silica	.29
Phosphoric acid	.15
Water	14.62
	99.00

Contains 57.97 per cent. of metallic iron.
LOCALITY: *McClanahan's Furnace, Shelby County.*

No. 37. A mass of ore, apparently very pure, presenting a number of conical prominences on the surface, glazed outside, and within made up of fibres radiating from the axis—of dark wood-brown color. Sp. gr.=3.691.

Analysis—

Per-oxide iron	84.32
Sesquioxide manganese	.41
Alumina	.89
Silica	1.19
Phosphoric acid	trace
Water	13.36
	100.17

Contains 59.02 per cent. of metallic iron.
LOCALITY: *Oxford, Benton County.*

No. 36. Also seemed a very pure mineral, of small columnar structure, each little column or cylinder being made up of fibrous ore radiating from the axis—dark brown. Sp. gr.=3.804.

Analysis—

Per-oxide iron	84.37
Sesquioxide manganese	trace
Lime	.08
Alumina	1.24
Silica	.15
Phosphoric acid	.56
Water	12.78
	99.18

Contains 59.06 per cent. of metallic iron.
LOCALITY: *Above Spencer's, Talladega County.*

No. 41. Compact dark brown ore—part of the specimen cellular, and presenting traces of a yellow earthy powder. Sp. gr. =3.288.

Analysis—

Per-oxide iron	82.45
Sesquioxide manganese	.63
Alumina	.77
Lime	trace
Magnesia	trace
Phosphoric acid	trace
Water	12.70
Insoluble (silica, with a little alumina)	3.21
	99.76

Contains 57.71 per cent. of metallic iron.
LOCALITY: *Benton, (upper bed).*

No. 48. Reddish-brown cellular mass, presenting traces of fine fibrous structure. Very dense and hard. Sp. gr.=3.262.

Analysis—

Per-oxide iron	80.65
Sesquioxide manganese	.26
Alumina	.09
Magnesia	trace
Phosphoric acid	.92 !
Water	12.37
Insoluble (silica, with a little alumina)	5.58
	99.87

Contains 56.45 per cent. of metallic iron.
LOCALITY: *Bluff Creek, North Alabama.*

No. 39. Exceedingly cellular—composed of thin sheets of compact and fibrous ore, sometimes running together into a compact mass, earthy ochreous material filling some of the cavities.

Analysis—

Per-oxide iron	69.22
Sesquioxide manganese	.98
Phosphoric acid	.09
Water	13.21
Insoluble siliceous residue	16.24
	99.74

Contains 48.45 per cent. of metallic iron.
LOCALITY: *Spencer's, near Oxford.*

No. 45. Like the last mentioned specimen, but not so cellular, and containing in the cavities more soft ochreous matter. Sp. gr. of compact portion=3.389.

Analysis—

Per-oxide iron	68.13
Sesquioxide manganese	.46
Alumina	.46
Phosphoric acid	.02
Sulphur	trace
Water	10.89
Insoluble portion	20.02
	99.98

Contains 47.69 per cent. of metallic iron.
LOCALITY: *Benton, (quarry near furnace.)*

No. 43. Dark brown compact ore, containing large hollows filled with yellowish or reddish ochre, or with a white earthy substance, or empty—the surface highly glazed and irised. Sp. gr. of compact portion=3·732.

Analysis—

Per-oxide of iron	73.64
Sesquioxide manganese	.13
Alumina	1.41
Phosphoric acid	trace
Sulphur	trace
Copper	trace
Water	9.77
Insoluble (silica, with alumina, and traces of iron)	15.49
	100.44

Contains 51.55 per cent. of metallic iron.
LOCALITY: *Benton (quarry near furnace).*

No. 38. A dense compact ore of rather lighter brown color than the preceding—very little ochreous matter. Sp. gr.=3.805.

Analysis—

Per-oxide iron	85.72
Alumina	.09
Phosphoric acid	.12
Water	11.07
Insoluble siliceous residue	1.78
	98.78

Contains 60 per cent. of metallic iron.
LOCALITY: *Spencer's, near Oxford.*

No. 40. Generally like preceding specimen—running into fibrous ore in places—contained ochre in cavities in the mass, and a little of a whitish earthy substance lining some very small hollows. Sp. gr.=3.363.

Analysis—

Per-oxide iron	72.18
Sesquioxide manganese	1.92
Alumina	.73
Phosphoric acid	trace
Water	11.55
Siliceous (insoluble) residue	13.85
	100.23

Contains 50.53 per cent. of metallic iron.
LOCALITY: *Above Spencer's, near Oxford.*

No. 42. Made up in great part of soft yellow and red ochre, filling large cavities in compact brown ore.

Analysis—

Peroxide iron	76.84
Sesquioxide manganese	.37
Alumina	2.34
Magnesia	trace.
Phosphoric acid	1.08
Water	13.76
Insol. (silica with alumina)	5.17
	99.56

Contains 53.79 per cent. of metallic iron.
LOCALITY: *Benton, (upper bed.)*

No. 46. Light cinnamon-brown ore; very cellular, and containing much intermixed yellow ochre.

Analysis—

Peroxide iron	65.65
Sesquioxide manganese	1.33
Alumina	.92
Phosphoric acid	.13
Water	9.30
Insol. matter	22.37
	99.70

Contains 45.95 per cent. of metallic iron.
LOCALITY: *Wm. Johnson's, near Oxford.*

No. 47. Rather loosely aggregated granular mass, consisting of quartz grains and dark brown iron ore; contained numerous little hollows.

Analysis—

Peroxide iron	28.76
Sesquioxide manganese	2.57

Alumina	1.12
Lime } Magnesia }	trace.
Phosphoric acid	.08
Sulphur	trace.
Water	6.12
Insol. residue (quartz)	60.94
	99.59

Contains 20.13 per cent. of metallic iron. Scarcely deserves to be called an iron ore.

LOCALITY: *Near Oak Bowery.*

CLAY IRON-STONE.

No. 49. Compact, of a dark brownish-grey color, verging upon black; dense and uniform in appearance. Sp. gr.=3.495.

Analysis—

Carbonate of protoxide iron	86.85
" protoxide manganese	3.04
" lime	2.12
" magnesia	.12
Peroxide iron	.43
Alumina	.06
Water	1.17
Carbonaceous matter	trace.
Insol. (silica, with a little alumina, and traces of peroxide iron and lime)	6.37
	100.16

Contains 42.23 per cent. of metallic iron.

LOCALITY: *Jefferson county.*

No. 50. Close compact mass of uniform dark-grey color; ex-

terior (of bed?), to a depth of about a quarter of an inch, of a reddish brown color; the iron having been peroxidized. Sp. gr.=3.385.

Anal sis—

Carbonate of protoxide iron	70.84
" protoxide manganese	1.58
" lime	2.31
" magnesia	7.64
Peroxide iron	1.20
Alumina	.13
Water	.84
Insol. (of same composition as in No. 49)	14.94
	99.43

Contains 35.04 per cent. of metallic iron.

LOCALITY: *Walker County.*

In examining these iron ores, particular attention has been paid to the detection and quantitative determination of the foreign substances which occur in small quantity along with the essential ingredients of each ore, as these foreign substances, especially phosphorus and sulphur, affect so materially the quality of the iron produced, and therefore, their occurrence or absence may prove of much more importance than a difference in the *quantity of iron* yielded of several pounds in the hundred. The quantity of metallic iron contained in each ore has been calculated from the weight of peroxide obtained in the analysis, and of course the yield from the furnace would not prove to be so great, there being an unavoidable loss of iron in the slags.

To give an idea of the amount of this loss in the course of the process of reduction as it has hitherto been conducted in the State, two specimens of bloomery slag, (from Scott's furnace, on Shoal creek,) were assayed, and found to yield:

No. 71	44.8	p. c. of iron.
No. 72	48.6	

Beside the large percentage of iron existing in the slags as protoxide united to silica, No. 72 contained small granules of metallic iron disseminated through it, which were removed before assaying. Both specimens were dense, black, and crystalline in structure.

But a single specimen of the iron produced from Alabama ores was examined, and this, not as a sample of the average quality produced, but as a specimen of bad iron, of the defects of which it would be desirable to find the cause. It was from Talladega county, and was remarkable as being very inferior in quality—slaggy, harsh, and very far from uniform—the fragments cellular and but very imperfectly run together. Sp. gr. was found=6.490, but this is perhaps too low, as there may have been minute cavities in the fragment weighed. It left a large amount of residue insoluble in dilute sulphuric acid, and this residue on being tested proved to contain largely of phosphorus, but not of sulphur, (the hydrogen gas evolved during the solution of the iron was also tested for sulphur with a negative result;) it also contained very minute grains of quartz mechanically mixed with the iron. Unfortunately this specimen was not accompanied by any of the ore and limestone used, and hence it is difficult to suggest the proper remedy for its defects.

In connection with the iron ores may be mentioned an interesting incrustation or deposit from the stack of a blast furnace in Benton county. It occurred as a greyish-green mass of resinous lustre, apparently of crystalline structure, very firm and compact; hardness about equal to that of fluor-spar. Sp. gr.=5.172. It yielded on analysis—

[No. 44.]

Oxide zinc	97.77
Protoxide iron	1.21
Oxide manganese	trace.
Silica	.64
Carbon	.08
	99.70

,nd thus proved to be almost pure oxide of zinc, a substance vhich has been occasionally, though not very frequently, met vith under similar circumstances. Its occurrence here is probably :eferable to the limestone used, as all the specimens of iron ores rom Benton county subjected to analysis were carefully tested for zinc, and with negative results in every instance.

A specimen (No. 22) of blende or sulphuret of zinc, from Benton county, (the mineral from an accidental admixture of which the last mentioned zinc deposit was probably derived,) was tested for cadmium, and gave a distinct trace of that metal.

ORES OF MANGANESE.

Of these there were two specimens :

No. 20. A tolerably pure compact Psilomelane, containing a little oxide of iron in small cavities through the mass. Sp. gr.=3.712.

Assayed by Fresenius' and Will's method, it proved to be equivalent to 62.43 p. c. of pure peroxide of manganese, (mean of two experiments.)

From Talladega county.

No. 21. Also Psilomelane; very hard, and breaking with a smooth clean fracture. Sp. gr.=3.988.

Assayed as No. 20, it proved equivalent to 63.25 p. c. of pure peroxide of manganese.

LOCALITY: *Randolph county.*

LEAD ORE.

Galena from Benton county (No. 19) was carefully tested for antimony, the presence of which had been suspected, but it contained none of that metal. It was afterwards examined for silver by reduction and cupellation of lead produced—it yielded scarcely an appreciable trace. Sp. gr. = 7.561.

SUPPOSED AURIFEROUS PYRITES.

A specimen of iron pyrites, (No. 79,) from the gold region, Coosa county, was examined carefully in the liquid way for gold. Eleven ounces of the pyrites (mixed with a good deal of quartz) gave a distinct trace of gold, sufficient to fuse before the blow-pipe to a minute globule.

COALS.

Of coal there have been four specimens investigated, as far as the determination of the amounts of coke, volatile matter, and ashes, which they severally yield—for their ultimate analysis there has not yet been time. Three of these specimens are from the Cahawba coal-field, and one from that of the Black Warrior. They are all free-burning bituminous coals, caking readily.

No. 73. Level bed, Cahawba coal-field. Tolerably firm coal, very bright and lustrous upon the surface, not soiling the fingers. Sp. gr. = 1.294.

Analysis—

Volatile combustible matter	35.51
Fixed Carbon	57.42
Ashes	6.31
Moisture	.76
Sulphur	trace.
	100.00

No. 74. Inclined bed, Cahawba coal-field, upon Mulberry creek. Like No. 73., but not quite so lustrous. Sp. gr. = 1.304.

Analysis—

Volatile combustible matter	36.68
Fixed Carbon	57.23
Ashes	5.30
Moisture	.79
Sulphur	trace.
	100.00

No. 75. Five-foot bed, Cahawba coal-field. Also very bright clean coal—not so distinctly bedded as No. 73. Sp. gr. = 1.310.

Analysis—

Volatile combustible matter	34.49
Fixed Carbon	60.09
Ashes	4.32
Moisture	.93
Sulphur	.17
	100.00

No. 77. Hewell's bed, Tuscaloosa: from the Southern extremity of the Warrior coal-field. The city of Tuscaloosa has derived

the principal part of its coal from this bed for some years past. Very distinctly bedded coal, breaking very easily into rectangular fragments, soiling the fingers—contains a good deal of iron pyrites on the surfaces of the fragments. Sp. gr. = 1.351.

Analysis—

Volatile combustible matter	40.60
Fixed Carbon	54.07
Ashes	3.09
Moisture	1.18
Sulphur	1.06
	100.00

The above analyses shew that Alabama coals are particularly well adapted to the manufacture of illuminating gas. An experiment made upon the small scale, with 8 lbs. of Tuscaloosa coal (Simms' Bed), which was distilled in a common iron mercury-bottle—a very imperfect apparatus for the purpose—yielded 32 cubic feet of gas of good quality, a very large amount in view of the necessarily wasteful manner in which the process was conducted.

A bituminous slate, from Horse Shoe Bend, Tallapoosa Co., which has been sold as plumbago, and which, when pulverized, mixed with water into a paste, and dried, actually bears considerable resemblance to that substance, was burnt with oxide of copper and chlorate of potash in order to ascertain the amount of carbon really contained.

(A) The solid mineral, unground, gave 2.37 p. c. of carbon.

(B) The dried paste, made from powder of the same, gave 2.31 p. c.

Another bituminous slate, No. 28, from Cook's, near Ball-

Play Mountain, gave .86 p. c. of carbon. It effervesced strongly with muriatic acid, dissolving to a considerable extent.

With regard to the soils and mineral waters of the State, the time available for the labors of the Chemical Department of the Survey has been quite insufficient as yet to permit making anything like an accurate examination of the specimens which have been collected. A few springs have been tested as to the nature of the mineral matter held in solution in them, but no quantitative analyses have been undertaken, the specimens on hand, both of soils and mineral waters, being set aside until, as it is hoped, time may be available for their proper investigation.

Besides the analysis of the minerals noticed above, a number of specimens of metallic ores, or substances supposed to be such, and of some other minerals, have been examined at the request of individuals in different parts of the State, and the results communicated to the persons requiring information.

Since the above report was written, some other analyses have been made, of which the results are as follows:

No. 93. A light greyish-blue rock, slightly mottled with spots of a darker blue, and with little veins of white carbonate of lime—very compact and dense, with uneven fracture. Sp. gr. =2.854.

Analysis—

Carbonate lime	56.53
Carbonate magnesia	40.08
Peroxide iron	1.44

Alumina	trace.
Insol. (siliceous) residue	.98
	99.03

LOCALITY: *Peckerwood creek, Talladega county.* An excellent marble or building stone.—See p. 73, Prof. TUOMEY's Report.

No. 83. A limestone of very uniform light smoke-gray color—breaks with a splintery conchoidal fracture. Sp. gr. = 2.714.

Analysis—

Carbonate lime	98.89
Carbonate magnesia	.68
Alumina and peroxide iron	.16
Insol. matter (siliceous)	.19
	99.92

LOCALITY: *McClanahan's Iron Works.*

This is the limestone used at the iron works (see Report, p. 99). The analysis shows its high degree of purity.

No. 82. A limestone of uniform smoke-gray color, with very few white spots—harsh, and breaking with a splintery fracture. Sp. gr. = 2.714.

Analysis—

Carbonate lime	98.07
Carbonate magnesia	trace.
Alumina and peroxide iron	.24
Insol. matter (siliceous)	1.49
Carbonaceous matter	trace.
	99.80

LOCALITY: *Shelby county.*

This is obviously identical with No. 83; and, like it, is admi-

rably adapted for use in the smelting of iron, or for burning into lime.—See Prof. TUOMEY'S Report, p. 123.

No. 81. A very dark grey, almost black, marble—nearly uniform in appearance—presenting a few spots of white carbonate of lime—breaks with imperfect conchoidal fracture. Sp. gr. = 2.721.

Analysis—

Carbonate lime	96.22
Carbonate magnesia	.37
Peroxide iron	.41
Alumina	.14
*Phosphoric acid	trace.
Insol. matter (siliceous)	3.08
Carbonaceous matter	.09
	100.31

LOCALITY: *Six-Mile creek, Bibb county.*

Nearly as pure a limestone as the two preceding, yet said by Prof. TUOMEY to yield a lime of slight hydraulic properties. I have not examined it in this respect myself.

No. 92. A rather hard light-grey rock, of uniform compact texture, but containing many shells. Sp. gr. = 2.695.

Analysis—

Carbonate lime	98.31
Carbonate magnesia	.55
Peroxide iron and alumina	.14
Phosphoric acid	trace.
Insol. (siliceous) residue	.36
	99.36

*Detected by molybdate of ammonia.

LOCALITY: (This specimen, which was placed in my hands by Prof. TUOMEY but a very short time before his death, had attached a label, with merely this inscription, "30 feet below the top limestone." By comparing it with other specimens, however, I feel little hesitation in referring it to the carboniferous rocks of Blount or Morgan County.) Obviously well adapted to the manufacture of excellent lime.

No. 91. A small hard mass of rudely cylindrical form, light brownish color, granular in the interior, but coated with a crust of radiated structure; looked something like a coprolite; about an inch in diameter. This was tested for phosphoric acid, with a view merely to determine its origin—10. grms. yielded but .0114 of PO_5=.114 per cent. It is a mere calcareous concretion.

LOCALITY: *Chunnennugga.*

No. 88. A hard concretionary mass of large shells, with fragments of fossil bone, and some few quartz pebbles—cementing material something like the marlstone, No. 84, from the Alabama river. Owing to structure, the density of the mass was not taken.

Analysis—

Carbonate lime	70.84
Carbonate magnesia	trace.
Alumina	1.94
Peroxide iron	.04
*Phosphoric acid	.103
Silicic acid (soluble in muriatic acid)	.21
Insoluble matter (chiefly quartz sand, a little clay, and a few spangles of mica)	26.26
	99.393

LOCALITY: *Railroad cut, near Columbus, Georgia.*

*By molybdate of ammonia.

Likely to yield lime of good quality for agricultural purposes See Prof. TUOMEY's Report.

No. 84. Cretaceous marlstone—a uniform mass of finely granular structure, dingy-white or grey color, in which abundance of quartz sand is visible—in small pieces easily rubbed down into grains between the fingers. Sp. gr. of the mass not taken.

Analysis.

Carbonate lime	27.37
Per-oxide iron	1.20
Alumina	.34
Phosphoric acid	·04
Chloride sodium	trace.
Insoluble matter (quartz sand, with a little fine mud and little spangles of mica)	70.81
	99.76

LOCALITY: *Alabama River, in (Lowndes county?)*

Fragments of the fossil jaw and teeth (of *Leiodon?*) occur with the specimen, but these were not included in the portion taken for analysis.

No. 85. Marl, of bluish or greenish-grey color (the color becoming much darker on moistening the marl)—sandy, more easily friable than No. 84, with particles of mica, and minute fragments of shells.

Analysis—

Carbonate lime	21.42
Carbonate magnesia	.16
Per-oxide iron	2.88
Alumina	.15
Phosphoric acid	trace
Chloride of sodium	trace

Insoluble matter (quartz sand, fine mud, and spangles of mica—rather more of the finely divided matter than in No. 84)	75.08
	99.69

LOCALITY: *Beneath tertiary limestone, Troy, Pike County.*

No. 86. Marl, resembling No. 85, but more impalpable in texture, and more plastic when wet—unctuous; cuts with a smooth, glistening surface—contains spangles of mica, and shells—some much larger than those of No. 85.

Analysis—

Carbonate lime	25.87
Carbonate magnesia	.31
Per-oxide iron	3.23
Alumina	.94
Phosphoric acid	trace
Chloride sodium	trace
Insoluble (as in 84 and 85—more of fine sand and mica, less of quartz sand	68.71
	99.06

LOCALITY: *Chattahoochee River.*

No. 87. Marl, quite similar in appearance to No. 86—specimen analyzed contained a pretty large *Inoceramus.*

Analysis—

Carbonate lime	13.47
Carbonate magnesia	1.01
Per-oxide iron	3.21
Alumina	1.08
*Phosphoric acid	.176

*By molybdate of ammonia.

Silicic acid (soluble in muriatic acid)	.54
Insoluble matter (finely divided clay, sand, and specks of mica)	79.14
	98.626

LOCALITY: *Below Eufala.*

The last three analyses represent well the general composition of a class of marls abundant about the junction of the cretaceous and tertiary formations. See Prof. Tuomey's Report. I, have already, in this report, noticed the very uniform occurrence of traces of chloride of sodium in the marls of the newer formations.

No. 89. A very soft, friable marl, of yellowish-brown color, full of small shells and their fragments.

Analysis—

Carbonate lime	23.18
Carbonate magnesia	trace
Per-oxide iron	3.35
Alumina	.32
*Phosphoric acid	.057
Silicic acid (soluble in muriatic acid)	.30
Insoluble matter (like that of No. 84; much quartz sand)	72.06
	99.267

LOCALITY: *Kennedy's; 5 miles southwest of Camden.*

This marl has obviously the same composition with Nos. 84, 85, 86. The difference of color is no doubt owing to the existence of the iron as per-oxide in this, but as protoxide in the other three.

*By molybdate ammonia.

No. 80. Gypsum marl. Three specimens were examined—all consisted of gypsum crystals cemented together by a greyish calcareous mud or marl, (stained by per-oxide iron,) by which mud also the crystals are often clouded, the whole forming a very feebly coherent mass.

In A, the crystals were an inch or an inch and a half long; much larger crystals, however, are found at the locality.

In B, the crystals were smaller, and little shells were mingled with the marl.

In C, the gypsum crystals were much less distinct, and seemed to have lost water, having become white and opaque.

The sulphuric acid was determined, and from its amount that of pure gypsum was calculated.

(A) gave 93.89 per cent. of gypsum ($CaO, SO_3, 2HO$.)
(B) gave 67.83 " " " "
(C) gave 54.40 " " " "

The quantity of carbonate of lime in the marl was determined (volumetrically) for (B) and (C).

(B) yielded 12. per cent.
(C) yielded 40.5 per cent.

LOCALITY: *Mr. James Jackson's, Gainestown, Clarke County.*

A memorandum, in Prof. TUOMEY'S handwriting, gives the following account of the geological position of this gypsum. "A section at Gainestown presents, in descending order, marl, 40 feet thick; yellow crystalline limestone or marble, 2½ to 3 feet thick; second bed of gypsum, 3 to 4 feet thick; second bed of yellow marble, 2 to 3 feet thick; hard orbitoidal limestone, 15 feet thick; white limestone, variable in thickness". See also, further on, Mr. Thornton's Report. The great value of this marl for agricultural purposes is evident. Gypsum will richly benefit soils to which it may be applied, and the carbonate of lime will also prove of some service.

No. 90. A very light, soft, porous mass, of dark brown color, or reddish-brown on the surface, (owing to presence of per-oxide of iron.) Contains a very large amount of organic matter, burning away when heated to redness, and leaving a brown ash. On boiling with caustic soda, distinct traces of ammonia were given off. Tested for uric acid, but no distinct reaction was afforded. Phosphoric acid being discovered, its amount was very carefully determined. The substance yielded 7.698 per cent., equivalent to 16.80 per cent. of tri-basic phosphate of lime—a little phosphoric acid was, however, combined with magnesia.

LOCALITY: *Plantation of George Turk, Esq., about* 3 *miles West of the village of Brooklyn, Conecuh County.* Found in a cave in white orbitoidal limestone, covering the floor to the depth of several inches. Supposed to be a kind of "guano," although no remains of animals were found with it. Bats have been seen. If obtainable in quantity, its phosphoric acid alone would render it a valuable fertilizer. The cave is about 300 feet in length by 30 or 40 feet in width, and is said to have been formerly a resort of Hare, the pirate.

APPENDIX No. 2.

REPORTS OF MR. E. Q. THORNTON,

ON PORTIONS OF THE

Cretaceous and Tertiary Formations.

To E. Q. Thornton, Esq., assistant to Prof. Tuomey during the progress of the Survey, was assigned the duty of tracing the Northern and Southern boundaries of the great Cretaceous formation of the State; in doing which, he not only defined the limits of the formation as a whole, enabling its position to be laid down upon the map with greater exactness than was before possible, but also examined the space occupied by the various beds of which the formation is composed, determined the relative position of these beds, and collected specimens of fossils, rocks, and soils characteristic of the districts passed over.

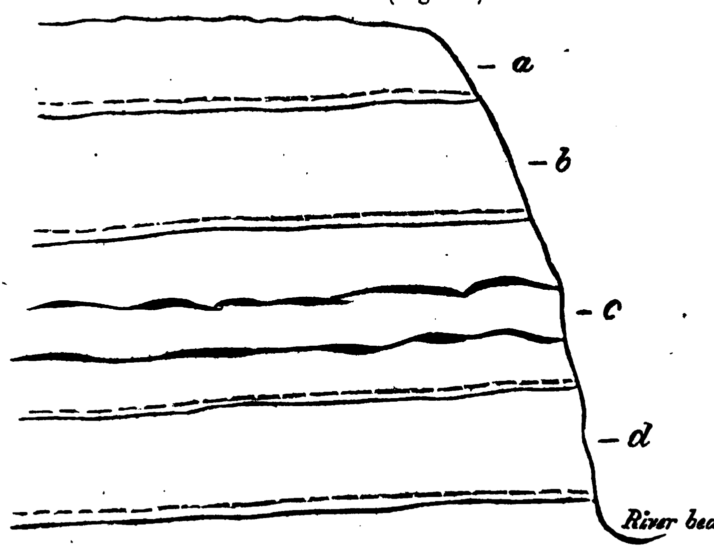
The portion of Prof. Tuomey's Report treating of the lower part of the State being incomplete, (see close of Chap. V.,) it became specially desirable that the results of Mr. Thornton's labors should appear, and therefore I append some notes, furnished by him to Prof. Tuomey, upon the southern boundary of the cretaceous formation—(C.) These notes, however, do not fully supply the missing matter, or completely represent Mr. Thornton's work, as he had not considered it necessary to describe several localities visited by him and afterwards by Prof. Tuomey himself.

I also add in this place some notes by Mr. Thornton upon an examination of part of the northern boundary of the cretaceous, both in this State and in Mississippi—(A. and B.). [J. W. M.]

A.

NOTES OF SECTIONS OBSERVED IN MONTGOMERY AND LOWNDES COUNTIES.

SECTION I.—(Fig. 30.)



This locality is at CHAS. GUNTER'S, ESQ., ten miles West of Montgomery, opposite Manack's Island, in the Alabama River.

a. Sand, pebbles, and red clay loam, which are almost universally found overlying the other rocks, south of a certain line. Among these beds of sand, &c., are occasionally found the stems of *encrinites*. On the surface of this stratum, and mingled with

the soil, near the river, are beds of *unios* and other fresh-water shells, together with arrow points and remains of Indian pottery. The shells were doubtless placed here by the aborigines, after having made use of their contents.

b. Calcareo-argillaceous rock, known indifferently as rotten limestone, (the common name,) blue limestone, joint clay, or marl. The disposition to split into joints has caused it to be called joint clay. In this stratum there are few fossils, with the exception of the *Inoceramus*, of which there are several species. The shell has disappeared, leaving only the *cast.* This stratum does not extend to the river at this place, but may be seen beautifully exposed higher up the creek at Prairie Bluff.

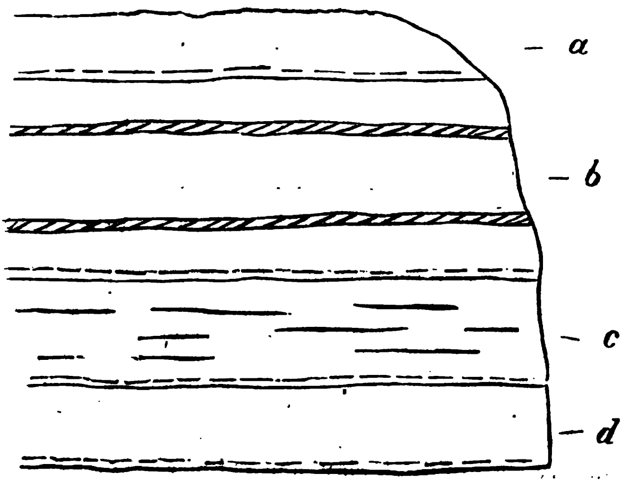
c. A greyish colored sand. Through this are running indurated seams of shells cemented together, causing a succession of little falls in Pintlala creek. The shells are principally the *gryphea*, *exogyra*, *ostrea*, sharks' teeth of various kinds, and some belonging to the class of *echinoderms.* This is the most fossiliferous bed.

d. This is the lowest stratum exposed at this place. It has a similar appearance to the one overlying it, but differs from it in having no seam of conglomerate. Small black grains are scattered through it, which give the characteristic test for green-sand. Large rounded masses are seen projecting from this bed, and strewing the base of the bluff. They vary from the size of a cannon ball to that of a mill-stone. It is evident that they are not water-worn, but are made by the cementing of the sand and iron which they contain. *Baculites* and other fossils are found in this, but are too much decomposed to be obtained in any perfection.

Higher up the river another bed is seen outcropping from under this, composed of black laminated clay, intermingled with green-sand. In almost every locality where the river cuts a sufficiently deep channel, two strata of sand, separated by a layer of this dark clay, may be seen. At Vernon, northwest of this, where the lower beds are not hidden by the rotten limestone, this same thing may be seen. They seem to correspond to

upper and lower greensand of England. These beds crop out from under rocks of a more recent age in places at a distance of from ten to twelve miles north of the calcareous portion of the cretaceous formation. A line drawn at this distance from that marking the limits of the rotten limestone, would include the siliceous portion of this formation.

SECTION II.—(Fig. 31.)



House Bluff, southeast of Mulberry Post Office. At this place the river has cut out a deep narrow channel. The bluff to the right side is perpendicular, and rises to the height of at least 150 feet, exposing many of the cretaceous beds.

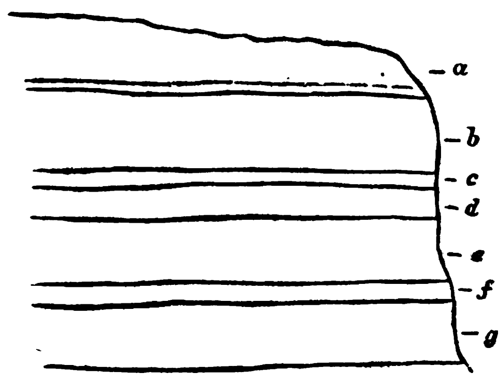
a. Rotten limestone a few feet in thickness. This has a bluish color when moist, but is white when perfectly dry. A few hundred yards down the river this stratum gives out.

b. A grayish sand similar to that seen at the landing at Montgomery, with two bands of conglomerate of fossils, principally *ostrea cretacea*, about ten feet apart. The shells are cemented together by a ferruginous sand. Echinoderms and sharks' teeth of various sizes, are found with them.

c. Blue laminated clay, intermingled with sand, without fossils.

d. Greensand. This would be more properly called the lower greensand, for the upper stratum (*b*) also contains a small quantity of greensand. The upper stratum is generally of a grey or yellow color, while the lower has mostly a bluish hue.

SECTION III.—(Fig. 32.)



DR. JNO. WOODS', on bend of river opposite Benton, and south-west of House Bluff.

a. Surface beds of sand, clay, and pebbles.

b. Rotten limestone, containing here vast numbers of *Inocerami* of a size varying from ten to fifteen inches in length—masses of *lignite* bored by the *teredo*, and the casts of many other fossils.

c. Immediately under *b*, and in such close contact as to be almost inseparable from it, is a hard calcareous sandstone, containing large particles of greensand. In this rock were found numerous fossils; among them portions of the head of the *mosasaurus*. When exposed to the atmosphere assumes a yellow cast from the oxidation of the iron it contains.

d. Hard conglomerate of shells and ferruginous sand. The sharks' teeth are noticeable in this stratum from their great number—species of the family of *echinoderms* are numerous.

e. Greyish sand about 3 feet in thickness.

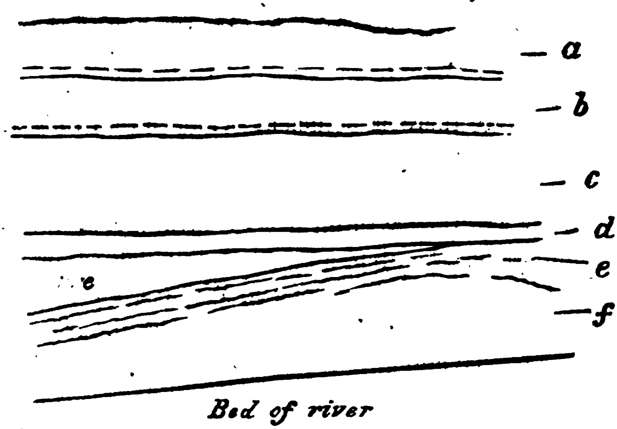
f. Second conglomerate of shells similar to first, viz. *d*.

g. Bluish sand, extending down beneath the surface of the river.

This section is somewhat different from the one at House Bluff, but on the whole they present much the same features.

The course of the Alabama river from Montgomery to Selma being westward, and keeping on the northern boundary of the rotten limestone, affords in many places a fine opportunity for studying the lower cretaceous beds.

SECTION IV.—(Fig. 33.)



COL. MORGAN'S Landing, two miles west of DR. WOODS'.

a. Surface bed, alluvial soil.

b. Conglomerate of sand and fossils.

c. Gray sand.

d. Second conglomerate, one foot in thickness, similar to *b*.

e. Bed of dark micaceous sand, containing quantities of comminuted shells, and *anomiae* in a fine state of preservation. When deprived of the decomposed shells, there is no lime in this deposit. It is of limited extent, gradually thinning out to the west.

f. Bluish sand, with a layer of *Ostrea cretacea*, echinoderms, sharks' teeth, &c., towards its upper surface. The *pecten 5-costatus* is also found here.

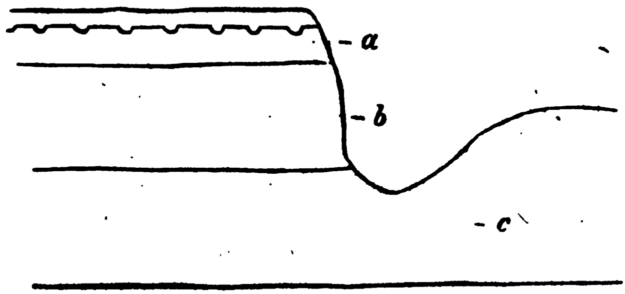
This section is very similar to section III.

The last two sections correspond well with the experience of the well-borers about Selma. After going through the rotten limestone it is necessary to peck through a number of hard rocks, and I have seen portions brought up exactly like rocks taken from these bluffs. The fossils, also, portions of which are sometimes brought up, correspond with those seen in the rocks of the river bluffs.

There are other bluffs similar to the last mentioned, but so much alike that it is not necessary to give sections of them. At Mrs. Smith's plantation, south of Burnsville, there occur in the beds of grey sand large rounded masses similar to those seen at Gunter's. Here there is sufficient evidence that they are not worn into this shape by water, from the fact that sharks' teeth and various shells are seen exposed on the surface, and when exposed to the sun they scale off in concentric layers like onions.

At Cunningham's landing, a section of which would be the same as that given of the bluff at Dr. Wood's, I found teeth of the *mosasaurus* in the same position in which the fragments of the jaw-bone of this animal were seen higher up the river.

SECTION V.—(Fig. 34.)



Bluff at Benton, Lowndes county.

a. Bed of loam. About a foot beneath the surface is a layer of fresh-water shells, six inches thick, in a fair way to become fossil. These were taken from the river by the Indians, as may be discovered by the arrows and broken pottery mingled with them.

b. Blue clay, without fossils. This is also an alluvial deposit. Beneath this bed, and lying on the surface of *c*, are large logs of wood, which are slowly being converted into lignite, together with the leaves by which they are surrounded.

c. Rotten limestone. The *Inocerami* which strew the bluff are very large, some of them measuring fifteen inches in length. One may here observe the shells undergoing the process of convertion into iron pyrites. Besides the more common fossils, a few *coprolites* were found at the mouth of Old Town creek. Some years ago portions of the *mosasaurus* were taken from this bluff.

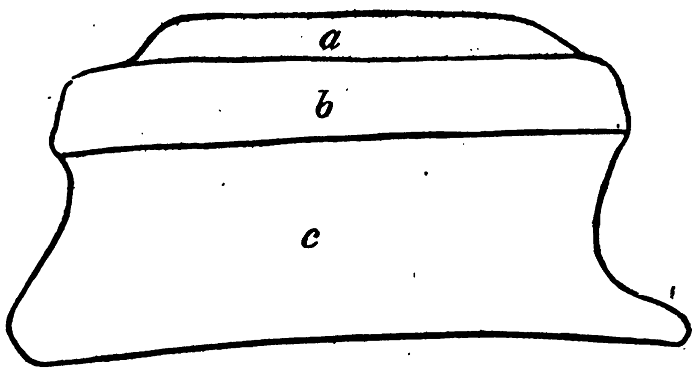
There is little difference to be observed in the character of the bluff, made up of the rotten limestone. There are some accidental differences which deserve notice. At King's landing and at White Bluff below Cahaba, where cracks occur in the limestone, they are filled with calc spar, which is often mistaken for quartz. At Hatcher's Bluff, below Selma, there is also a slight variation. Towards the top of the bluff, the rock becomes much harder and whiter than any that has hitherto been mentioned, from the fact that it contains a greater quantity of lime.

SECTION OF COUNTRY BETWEEN SELMA AND BENTON.

That portion of Lowndes and Dallas counties bordering on the river between Benton and Selma is level sandy pine-woods land; underlying this is the blue marl, which on coming to the surface makes the prairies which are seen farther from the river. Beds of sand and ferruginous sandstone are occasionally seen in the interior of the county, as at Lowndesboro, making a good location for the village. Beds of sand and pebbles also crown the highest hills.

The localities of greatest interest in this formation are found on the river, where it has cut through the rotten limestone, and exposed the underlying rocks. There are, however, in the interior some points which deserve mention.

SECTION VI.—(Fig. 35.)



Collirene, Lowndes county, section of hill or mound.

a. Sand and pebbles. In this bed portions of the stems of encrinites are sometimes found.

b. Hard calcareous sandstone, with *exogyra costata, gryphaea convexa, turritella vertebroides* (cast), echinoderms, sharks' teeth, &c.

c. Softer sandstone, which crumbles away, leaving the harder portion projecting over it. It is not possible to tell how far

down this extends, as the debris conceals the base. There is a similar hill to this on DR. B. RUDULPH's plantation. On the surface of the rotten limestone which surrounds these places are found many fossil crabs.

CEDAR CREEK.

That portion of Lowndes lying between Dry Cedar and Big Cedar is quite a broken country. This is doubtless caused by the unequal washing away of the limestone, which is of different degrees of hardness. A hard white limestone generally caps the hills. This is full of holes, caused, as Prof. TUOMEY has observed, by the washing away of portions of the clay before its induration. Under this is a softer limestone which yields when the harder part is carried off. There are several of these indurated seams in the limestone, giving rise to numerous steps or terraces. In some places large *nautili* literally strew the surface of the rock. Most of these are well preserved, being calcified internally. A new species of *ostrea* is also quite common; most of the other fossils are badly preserved. This limestone is not confined to Cedar Creek, but may be seen on Muscle, Wasp, and other streams flowing into Cedar Creek. It extends east to within a few miles of Centre Port on the Alabama river. To the south it is covered by beds of sand belonging to the tertiary formation. In the bed of the creek at the sixteenth-section bridge a crystalline limestone outcrops. This is made up almost wholly of fossils which have been calcified. Most of them belong to the genus *turritella*. Both of these strata are similar to those seen on the plantation of A. J. JENKINS, near Allenton, Wilcox county, which are but the continuation of the former. They both overlie the rotten limestone.

CENTRE PORT.

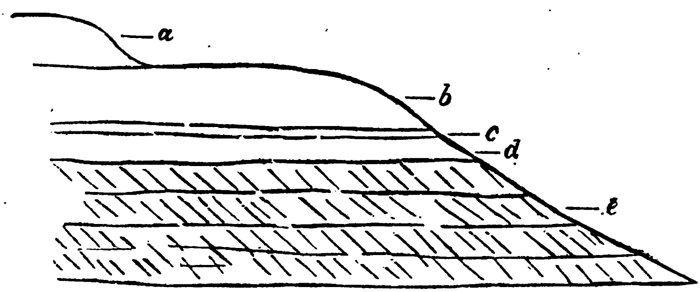
The bluff at this place is perpendicular for 160 feet, being composed to this height of solid blue marl or rotten limestone. Numbers of the more common fossils are sticking in the rock. *Pectens* of two species are found here well preserved. The bones of the *mosasaurus* were found by Mr. CROCHERON on his plantation. Red sand-loam to the depth of more than 100 feet lies above the limestone. The marks of stratification observed in this bed show that it has been deposited quietly in the waters. In one place was seen a layer of comminuted mica so pure as to resemble mica slate.

B.

EXAMINATION OF CRETACEOUS ROCKS IN MISSISSIPPI.

In order to gain a more extended and thorough knowledge of the rocks which constitute the cretaceous formation, I continued my examination of the northern boundary into Mississippi, where, as will appear from a few sections given below, the upper sands of this system are well exposed.

SECTION I—BARTON'S BLUFF.—(Fig. 36.)



a. Calcareo-argillaceous rock, splitting into joints—a few feet thick.

b. Grey sand, with particles of the color and size of grains of gunpowder. The most conspicuous fossils in this stratum are the *exogyra*, *pecten* 5-*costatus*, and *anomia*.

c. An indurated mass of sand, black pebbles, sharks' and other kinds of teeth.

d. Sand, with sharks' teeth, *Ostrea plumosa*, *Ostrea* (*sp.?*) &c.

e. Black laminated clay, intermingled with sand of a deep yellow color.

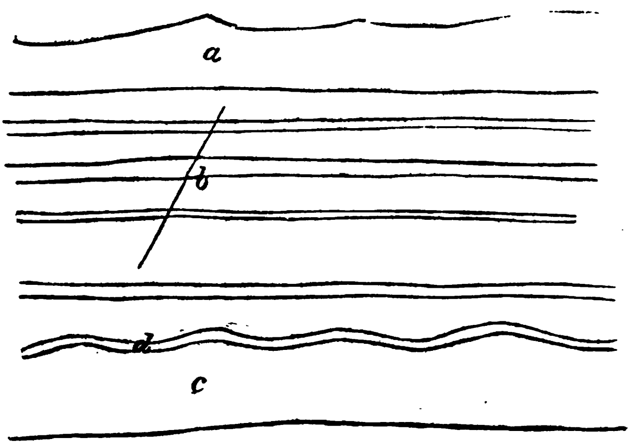
The interest in this bluff consists peculiarly in the bed of sharks' teeth, and in the stratum of dark laminated clay and sand. The number of teeth in the indurated rock (*c*), and the sand underlying it (*d*) is immense. Bushels, perhaps, of them have been carried away, and still they may be seen in abundance after every freshet. All the pebbles in this rock are dark. The underlying sand is equally full of fossils--besides the sharks' teeth, a new species of *Ostrea,* and vertebræ, apparently mammalian.

The dark laminated clay is intermingled with sand, which is not horizontally stratified.

Lower down, at the old ferry at Colbert, the black clay may be seen intermingled with greensand. Here, too, the indurated rock is exposed by the washing away of the superimposed rocks which are seen at Barton's bluff.

This stratum of dark colored clay does not always appear.

SECTION II—PLYMOUTH BLUFF.—(Fig. 37.)



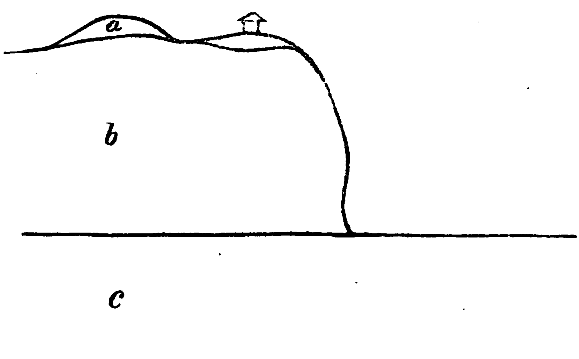
a. Calcareo-argillaceous rock.
b. Grey sand.
c. Greensand.
d. Layer of fossils, one to two inches in thickness.

The upper stratum (*a*) contains, besides the common cretaceous fossils, immense numbers of *Hamulus onyx.* Some magnificent specimens of *Ammonites* have fallen down from above.

The stratum (*c*) is similar to that seen at Barton's bluff, with very few fossils. Through it and horizontal with it are four indurated strata. From the lowest one of these (4) have been taken a large number of *ammonites, nautili, inocerami, trigoniae,* &c. These indurated strata being much harder than the sands through which they run, offer more resistence to the water and form projections. Every freshet exposes new specimens.

The curved line (*d*) represents a layer of fossils which are conspicuous when the bluff has been newly washed by rains, presenting a white line, while the rest is blue. The fossils most numerous are *exogyra*, *o. plumosa*, and teeth of fish. There is a quantity of lignite in this lower stratum bored by the *teredo.* Here also were found the bones of some large *reptile*, but too friable to be well preserved.

SECTION III—COLUMBUS.—(Fig. 38.)



a. Beds of drift.
b. Grey sand.
c. Greensand.

The hills upon which Columbus is situated are composed of grey sand covered with drift some feet in thickness. Where the grey sand outcrops may be seen casts of *nautili*, *ammonites*, *baculites*, the shells of *pecten 5-costatus* and *exogyra*. When this grey sand is exposed to the atmosphere for a length of time the iron which it contains oxidizes and causes it to become red, and were it not for the fact that it contains fossils might be mistaken for the drift which overlies it. This sand may be seen marked with *baculites*, &c., on the hills from Columbus to Barton and from there to Aberdeen. The rotten limestone is rarely seen immediately on the river banks, but makes its appearance some three miles from the river. From a pile which had been brought to Columbus for the purpose of making quicklime I found a *Hippurite*.

C.

EXAMINATION OF THE SOUTHERN BOUNDARY OF CRETACEOUS FORMATION (AND NORTHERN OF TERTIARY) THROUGH THE COUNTIES OF BARBOUR, PIKE, BUTLER, CONECUH, MONROE, AND CLARKE.

BARBOUR COUNTY.

The cretaceous rocks in this county are hidden by superimposed strata of clay, sand, and pebbles, except on the hill-sides where they have been laid bare by the washing of rains, or where streams have cut through the superficial beds.

In the immediate vicinity of Eufaula, a sandy marl crops out in the bluffs of the river, and creeks flowing into it. Going South the beds of sand become thicker and entirely conceal the underlying formation. A few miles East and Northeast the surface of the country is broken, and in many places the rains have carried away the newer beds and exposed a black laminated clay which contains a small quantity of lime. When this marl comes to the surface it gives rise to a lasting productive soil, unlike that of the surrounding level country, which is loose and sandy. Land of this character may generally be known by its growth of oaks covered with long moss.

At Browder's bridge, one mile North of Fort Browder, the Cowikee has cut its way through two beds of marl. The upper stratum is compact and broken into joints. When moist it has a bluish color, but when dry it is white, resembling rotten limestone, but containing a much smaller quantity of lime. The

lower stratum is of a coarse sandy texture with scattering grains of greensand. The only fossils in this locality are *ostrea plumosa*, *anomia argentea*, *exogyra costata*, sharks' teeth of various kinds, and some casts.

These beds may be seen on Bear and Dry creeks, and constitute in many places the sub-soil of a strip of country from three to five miles in width, lying in the fork of south and middle Cowikee.

The presence of the marl is shown by white lime pebbles and crystals of calc-spar mixed with the soil. Cracks in the rock are filled with the latter mineral. Unlike most lime land, this has a growth of long-leaf pine. Here and there throughout this strip are spots of land, from an acre to two acres in extent, known as hog-wallow land.

A black laminated marl containing *ammonites*, *inocerami*, and other smaller fossils in a bad state of preservation crops out in the bed of Middle Cowikee.

From the bluff of North Cowikee, at Col. FREEMAN'S, five miles South of Glennville, a blue marl outcrops similar to that seen at Powell's mills, Russel county. The fossils are also the same, although the number of species is not so great. After leaving Glennville we see nothing of the cretaceous formation until we get to Uchee creek.

The absence of natural sections renders it almost entirely impossible to say what is the exact position of the cretaceous marls in relation to the rotten limestone, and superficial beds of sand concealing them from view renders it difficult to settle their precise limits.

PIKE COUNTY.

The lands of that portion of Pike County lying North of the ridge upon which Aberfoil, Union Springs, and China Grove are situated, are of an argillaceous lime character. These extend to the bald prairies of Montgomery. Where the country is level

the soils are loose and sandy. The creek or bottom lands, which are of considerable extent, are made by deposition of detritus from the waters of streams rising in the calcareous region farther North, and are consequently very productive where they can be drained or prevented from overflowing.

That portion of Chunnenugga ridge within the limits of this county is similar to that in Macon. Deep beds of white sand overlie a stratum of black or bluish laminated marl, which has a disagreeable taste and fœtid odor. No limestone is seen cropping out from the bluffs.

South of the ridge is a strip of calcareo-argillaceous land, varying in width from three to five miles, and running East through Macon and Barbour. Deep beds of sand come in farther South concealing the underlying rocks from view, except in the vallies of the Conecuh and Patsaliga rivers.

The last of the cretaceous formation is seen three miles North of Troy, cropping out from the banks of the Conecuh river. This rock is of such texture and hardness as to be suitable for mill-stones, to which purpose it is devoted. It contains a sufficiently large quantity of carbonate lime to enable it to be converted into quick-lime, which would be a valuable addition to the surrounding sandy soils. The most conspicuous fossil in this rock, and the only one well preserved, is the *Gryphea convexa*. When exposed to the air, the iron which this rock contains oxidizes and causes it to shale off. This is a serious objection to its use as a mill-stone.

The tertiary beds come to the surface at Troy. These, consisting of sand, clay, and limestone, rest conformably on the cretaceous rocks. At Troy we have two of these strata exposed. The first is a bluish clay which, when exposed to the atmosphere and dried, becomes quite hard. This specimen not having been subjected to any test, it is impossible to say what amount of lime it contains. The only fossil in this is the casts of *Turritella Mortoni*. The upper stratum is a coarse limestone. On the surface it has a rough appearance from the unequal wear-

ing away of the shells of the *ostrea* and the limestone. This stratum dips under a layer of yellow sand, which may be seen on the road a mile from town. The only evidence we have that this last stratum does not belong to the superficial beds which overlie the whole country is the presence of minute grains of greensand and casts of fossils. Masses of fossiliferous iron ore are scattered over the surface of the earth.

East of this place is a small scope of country of peculiar appearance, known as the Pocosson settlement. The vallies, which have the rank luxuriant growth of a swamp, are surrounded on three sides by a ridge of snow-white sand, which seems to have been heaped up by the tides on a sea-shore. The only occupant of the hills is a scrubby oak covered with long moss. The soil is exceedingly unproductive, and soon wears out by cultivation.

Seven miles South of Troy a sandstone comes to the surface, and still farther down a siliceous limestone, very porous, the shells of which (it contained great numbers) have been dissolved out, leaving only the casts. This substance is sometimes so cohesive and fine-grained as to be used for grindstones. The soils originating from this rock are unproductive.

Cropping out from under this siliceous clay, about three miles East of Valleytown, may be seen a greensand.

Again underlying this, is another bed of greensand with many tertiary fossils, most of them of small size. Where these lower beds come to the surface, they give rise to a stiff calcareo-argillaceous soil, which far surpasses in fertility those by which they are surrounded. These may be known by the fragments of shells intermingled with the soil. This marl can be easily obtained and applied to those lands which need lime.

Where the road from Valleytown to Millville crosses the Conecuh river, a white limestone is seen cropping out in the bed of the stream from under a bed of fossiliferous sandstone. This limestone is quite hard, and is very near pure carbonate of lime. It crops out farther North, in the hills, and is piled into heaps and burned. At Millville, and extending six miles North of

this place, is a fossiliferous sandstone with occasional masses of brown hematite. This is the same stratum which is seen at Troy and at Greenville. East of Millville the country becomes flat and level, the soil sandy, and continues such to within a few miles of Greenville. The long-leaf pine is the prevailing growth, and a long coarse grass covers the surface of the earth. On this account the lands are of some value, for the timber upon it, and for raising cattle, as they are sparsely settled, leaving a wide range for stock. They lie very well, and by a regular system of liming and manuring may be made productive. By negligent cultivation they are soon deprived of their original strength, and have not, as naturally fertile soils, the tendency to recuperate, that necessary ingredient, lime, being wanting to convert the vegetation which falls on it to a proper state to be taken up by plants.

CONECUH COUNTY.

At Hartley's and Dunklin's steam-mill, on Pigeon creek, is a compact bluish clay with indurated seams running through it. In general this clay contains no lime, but there are places where this substance is present in the form of decomposed shells. Teeth of sharks are the only fossils sufficiently well preserved to be distinguished.

This stratum is again seen at Tim's ford across the Patsaliga, and is here overlaid by a calcareous sandstone cementing the shells of a new species of *ostrea*, and the casts of many other fossils.

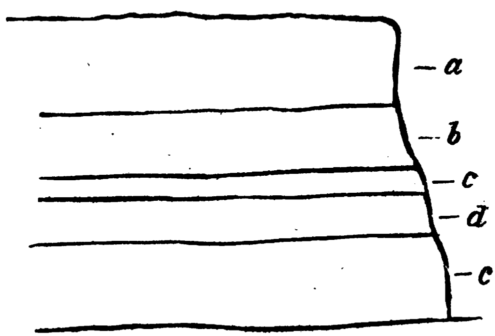
A few miles South of this, Simmon's creek has laid bare another calcareous sandstone filled with *O. alabamensis*, &c. This is very similar to the lowest stratum seen at Claiborne. Between the two last mentioned rocks intervene other beds of sand and clay. All of these dip under the white limestone which is first seen on Bottle creek.

At Brooklyn the Patsaliga has cut a channel through the

white limestone and a bluish calcareous clay. At GEORGE TURK'S, a few miles from this place, there occurs a cave of some notoriety in the white limestone. The roof is hung with stalactites and the floor is covered with a layer of excrements of animals which formerly inhabited this cave. This rock is sawed into blocks a foot square, and used for making chimnies. When exposed to the atmosphere in the mass for a length of time it becomes hard. This is the portion which is most usually converted into caustic lime. In many places it is so full of shells as to be rendered unfit for the purpose of chimnies. In this rock there are many fissures and small caves. This stratum extends ten miles below Brooklyn, and is rarely seen at a greater distance than five miles from the river, being covered by thick beds of sand and ferruginous sandstone. *Limesinks* constitute a remarkable feature in those sections of the country where this is the sub-stratum.

Leaving the white limestone to the North there are few localities of interest. At Spier's old ferry, on the Conecuh, is a bed of lignite.

SECTION I.—COAL BLUFF.—(Fig. 39.)



a. Surface beds of coarse red sand.

b. Bluish-white clay with casts of shells. This layer contains small transparent needle-like crystals, which have the taste of alum.

c. A bed of lignite twenty inches in thickness. A portion of the wood is converted into a dark compact substance, while the the greater part retains its original structure. On the surface is a white effloresence, caused by the decomposition of iron pyrites, which exists in the lignite in the shape of cubic crystals.

d. Purplish sand and clay.

e. Purplish sand and clay, with decomposed shells.

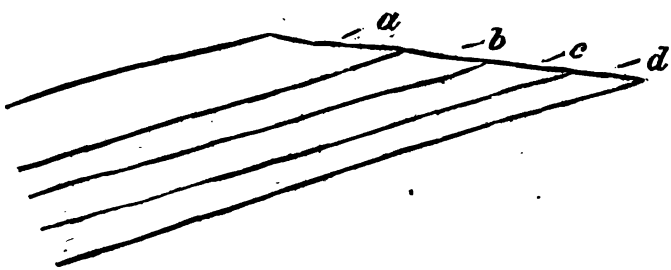
The white limestone again outcrops in this county a few miles below Sparta from the ridges which bound the bottom lands of Murder creek. It may be seen at Sparta on either side of the creek, between this place and Evergreen, in the plantations near Belleville, and various other localities. The lands of Murder creek are very extensive and quite fertile, from the fact that lime is carried down from the hills and spread over the soil. The uplands are for the most part sandy and unproductive. To these this marl might be applied with profit.

At Capt. TOMLINSON'S place on Cane creek, three miles directly North of Evergreen, several layers of calcareous sandstone similar to those on Simmon's creek, in the eastern portion of this county, outcrop from the hill-sides. Between these layers of limestone are beds of fossiliferous greensand marl containing a large per centage of lime. The country for several miles North of this is remarkably level, until it is rendered rugged by strata of hard siliceous clay and buhr-stone coming to the surface. In the fork of Persimmon and Sepulgah creeks immense hills are made up of this substance. Everywhere underlying this rock is a stratum of black laminated clay, from which, when exposed, project masses of crystalline limestone containing calcified shells and *septaria*. These last mentioned rocks constitute the substratum of a large scope of country. Inter-stratified with this dark colored clay are beds of greensand, sometimes fossiliferous, and at others free from shells. The first of this kind of beds occurs at E. D. STINSON'S, ESQ. At this particular locality there are white lumps of pure carbonate of lime mixed with greensand

and shells. The most common fossils are *Cardita planicosta*, *Crassatella alta*, *C. Alabamensis*, *Voluta*, *Corbula* and *Dentalium*. The depth of this layer could not be determined, as it extended below the surface of the water.

Three miles Northwest of this locality, at Mr. BENNET'S, a bed of non-fossiliferous greensand comes to the surface, and is the sub-soil of a whole section. As might be expected this land produces remarkably well. Those lands which lie under the hills, containing this mineral, are always of the most excellent quality, which fact goes to show the great benefit to be derived from its application. The following section will explain the relative position of the rocks in this country.

SECTION II.—(Fig. 40.)



a. White limestone.
b. Calcareous sandstone and beds of greensand.
c. White siliceous clay and buhr-stone.
d. Black laminated clay, inter-stratified with beds of greensand.

All these strata dip gently to the South, and as we travel North, we pass over them in succession. Of course therefore they run across the country from East to West, and when the position of one is known the others may be found.

MONROE COUNTY.

The white limestone of Conecuh extends into Monroe. At Burnt Corn it crops out from under beds of coarse red sand. At Monroeville many quarries have been opened in this rock for getting out blocks for chimnies. Here it is overlaid by deep beds of drift, composed of purple clays, sand, and pebbles, in all respects similar to the beds belonging to this formation higher up in the State. The limestone here abounds in a greater number of fossils than in any other locality previously mentioned. A single vertebra of the *zeuglodon* has been discovered, showing that this animal was confined to no particular portion of the tertiary seas. The white limestone is of great thickness. One prong of the Double-branches has cut its way through it, forming a cave some two miles in length. This cave is three miles West of the town. On Rock Branch, to the West of the town, is a bed of fossils, in all respects similar to the stratum underlying the white limestone at Claiborne, and occupying the same position. The fossils, which are also identical, are by no means so well preserved. Besides this there are also other beds of bluish clay underlying the limestone, with a few fossils, as at Mr. ROBERTS'. The white limestone sometimes contains an appreciable quantity of greensand. This is particularly noticeable at Mr. MCCORVEY'S, 8 miles Northwest of Monroeville. Here the shells have been dissolved out and the greensand has taken their place. This is much softer than usual, crumbling readily when broken up and exposed. The siliceous clay or buhr-stone formations cover a large portion of this county, as the high precipitous ridges near Cokersville, Turnbull, Pineville, Pine-orchard, and various other localities. Near Pine-orchard is a buhrstone filled with silicified shells, the most conspicuous of which is a *Cardium*. As in other places, so in this, the buhr-stone formation is underlaid by a blue laminated clay, intermingled with limited deposits of greensand. Examples of this are seen near Pineville and Midway. The limestone below Monroeville is

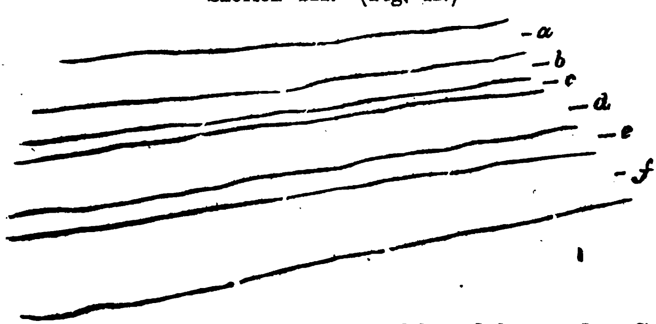
confined to a narrow strip of country near the river. That portion of the county South of Monroeville and Burnt Corn is a level pine-woods, with so little inclination as scarcely to permit the water which falls on it to flow off. Indeed, almost the entire surface of the county is made up either of coarse white sand or ferruginous sand and pebbles, and it is rarely the case that the underlying tertiary rocks come to the surface, except where the hills are precipitous or in the bluffs of streams. There is little or no variation in the character of the rocks or their relative position in this and Conecuh counties, nor was it to be expected, as they are adjoining, and the course of the rocks is regular.

GAINESTOWN, CLARKE COUNTY.

This is the most southern point of the eocene tertiary formation on the Alabama river. The last rock which disappears is an earthy limestone bored through and through by *teredo*, the only well preserved fossil which it contains with the exception of *scutellæ*. This never becomes so compact as the white chimney rock.

A section will show the position of the various layers at this locality better than any description.

SECTION III.—(Fig. 41.)



a. Earthy limestone, very loose, and bored by *teredo*. Sometimes it contains a quantity of iron, which oxidizing, cements,

forming tubes, and enclosing other substances. In this stratum, at Dr. SMITH'S, some miles above this, are found fragments of bones of the *zeuglodon*. It is generally underlaid by *b*, but sometimes beds of variegated clay containing the impressions of fossil leaves intervene.

b. Bed of marl from one to three feet in thickness. This is different from most of the marls in the State, being a mixture of bluish clay and crystallized gypsum. On the outer surface the gypsum is disintegrated. Although this bed is exposed only where there are abrupt declivities, yet there is evidence that it is extensive, for in various localities in the vicinity of Bailey's creek where trees are upturned, this substance is found adhering to the roots. The best specimen was seen at Dr NEAL SMITH'S, though that at Gainestown is little inferior to it.

c. A layer of crystalline limestone, three feet thick. This stratum extends two miles North of Gainestown, in the bluff which bounds the wide swamp on the western side. It may also be seen on the eastern side, higher up. Mr. JAS. M. JACKSON has opened a quarry in this and *e*, and has erected a mill for sawing it into slabs for table tops, mantels, and many other purposes. The shells, which are white, give it a variegated appearance which is quite beautiful. Holes are sometimes caused by the dissolving out of turreted shells, but this defect can be remedied by using some material of the proper color and hardness for filling them up. This stratum is broken by joints, which causes the quarrying of it to be much easier.

d. The only difference between this and *b* is, that besides crystals of gypsum it contains a quantity of carbonate of lime in small white lumps. It is three feet thick.

e. Yellow crystalline limestone two and a half to three feet in thickness. Same as *c*, but is of a deeper color and contains more shells.

f. White craggy mass of limestone, generally known as "horse-bone" rock. This is the rock which is almost always found on

the surface of little knolls protecting the softer underlying rock. This is particularly remarkable in the vicinity of Bailey's creek.

All of the above mentioned beds are, away from the streams, covered to a great depth by sand and pebbles.

APPENDIX No. 3.

LISTS OF FOSSILS

FROM THE

Cretaceous and Tertiary Formations,

IN ALABAMA AND MISSISSIPPI.

HAD Professor TUOMEY been spared to complete, by a final Report, the description of the results of his labors in Alabama, the most interesting and important part of such a work, in a purely scientific light, would undoubtedly have been that treating of the fossils of the more recent formations. Large collections were made during the active progress of the Survey, and these, on examination in due time, would have yielded an important basis of facts, upon which might be rested the study of the connection of these more recent rocks in this State with those of New Jersey and the Atlantic coast on the one hand, and with those of Texas and Nebraska on the other.

In view of the interest attaching to this subject, I add the following lists of cretaceous and tertiary fossils. They were in part drawn up before Professor TUOMEY's death, but have been extended, in preparation for the press, by examination of the labels of specimens in the Survey collection.

These lists are not to be looked upon as by any means complete—many Alabama species described by other authorities are not included here, and many of those collected during the Survey, which are new and as yet undescribed, are of course unnoticed. Some of the new species which are mentioned have been described, but some others have been merely named by Professor TUOMEY, and their description has never been published.

It is to be hoped that means may yet be found to properly examine and describe the collections of the Survey in this department.

[J. W. M.]

A.

GENERAL LIST OF CRETACEOUS FOSSILS.

Ammonites magnificus—*T.*,	Pickens county, Ala.
" carinatus—*T.*,	Columbus, Miss.
" lobatus—*T.*,	Ala.
" bi-nodosus—*T.*,	Eutaw, Ala.
" angustus—*T.*,	Columbus, Miss.
" ramosisimus—*T.*,	Ala.
" Conradi—*Mor.*,	Prairie Bluff, Uniontown, Ala.; Mississippi.
" placenta—*Mor.*,	Ala.; Miss.
" telifer,	Ala.
Anomia argentea,	Ala.
" tellinoides,	Ala.
Anthophyllum Atlanticum,	Ala.
Arca rostellata,	Ala.
Avicula lævis,	Eufaula, &c., Ala.
Baculites carinatus—*Mor.*,	Bridgeport, &c., Ala.; Miss.
" asper—*Mor.*,	Bridgeport, &c., Ala.; Miss.
" ovatus,	Prairie Bluff, Chunnennugga, Ala.
" labyrinthicus,	Ala.; Columbus, Miss.
" compressus—*Mor.*,	Bridgeport, Ala.
" columna—*Mor.*,	Bridgeport, Ala.

Belemnitella mucronata,	Livingston, Sumterville, Sumter county, Ala.
Belemnites Americanus,	Ala.
Bulla galba,	Ala.
" sp. (O.)	Ala.; Miss.
Cardita decisa,	Ala.
Cardium hemicyclicum—*T.*	Ala.
Cerithium nodosum—*T.*,	Miss.
Corbula caudata—*T.*,	Miss.
Crassatella sp.(O.)	Sumter county, Ala.; Miss.
Cucullea vulgaris,	Ala.
" antrosa,	Ala.
" ungulina—*T.*,	Greene and Sumter counties, Ala.
Cytherea excavata—*T.*,	Ala.
Dentalium (Hamulus—*Mor.*) onyx,	Ala.; Miss.
Exogyra costata,	Ala.
Fusus Eufaulensis—*T.*,	Eufaula, Ala.
" turriculus—*T.*,	Miss.
Gryphæa convexa,	Ala.; Miss.
" Pitcheri,	Ala.
" mutabilis,	Uniontown, &c., Ala.
" incurva,	Canton, Bridgeport, &c., Ala.
Hamites torquatus—*Mor.*,	Sumter and Greene counties, Uniontown, Bridgeport, Ala.
" arculus,	Ala.; Miss.

Ichthyosarculites cornutus,	Ala.
" quadrangulatus,	Ala.
Inoceramus salebrosus—*T.*,	Miss.
" Barabeni—*T.*,	Miss.
" inflatus—*T.*,	Miss.
" proximus—*T.*,	Miss.
" scalaris—*T.*,	Miss.
" Cripssii (?)	Miss.
" alveatus,	Ala.; Miss.
" bi-formis,	Cahaba, Ala.
Lucina sp.(O.)	Ala.; Miss.
Megalodon (Venilla) Conradi,	Jernigan's, Barbour county, &c., Ala.
Natica petrosa—*Mor.*,	Sumter and Greene counties, &c., Ala.; Lowndes county, Miss.
Nautilus Spillmani—*T.*,	Columbus, Miss.; Dr. Woods', Autauga county, Ala.
" De Kayi,	Prairie Bluff, Sumter county, Uniontown, Ala.
" orbiculatus—*T.*,	Cedar creek, Lowndes county, Dallas county, Butler county, Ala.
" angulatus—*T.*,	Ala.
Ostrea vomer,	Ala.; Miss.
" crenulata—*T.*,	Eufaula, Ala.
" falcata,	Eufaula, Montgomery county, Lowndes county, Sumter county, Ala.; Miss.
" cretacea,	House Bluff, Uchee, &c., Ala.
" sub-spatulata—*T.*,	Eufaula, Ala.
" larvata,	Ala.
" plumosa,	Uniontown, Eufaula, Ala.

Panopœa cretacea,	Ala.
Pecten quinque-costatus,	Eufaula, Elm Bluff, &c., Ala.; Miss.
" sp.(O.)	Elm Bluff, Ala.
Pectunculus hamula,	Eufaula, &c., Ala.
Pholadomya, (sp. ?)	Ala.
Phorus umbilicatus,	Montgomery, Sumter, Greene and Pickens counties, Ala.; Lowndes county, Miss.
Placuna scabra	Eufaula, &c., Ala.
Plicatula urticosa	Ala.
Pyrula Richardsoni—*T.*,	Miss.
" trochiformis,	Sumter county, Ala.
Radiolites undulatus,	Hatcher's Bluff, Ala. river, Pickens county,, &c., Ala.
" Aimesii,	Hatcher's Bluff, Ala. river, Pickens county, &c., Ala.
" laminosus,	Ala.
Rostellaria pennata—*Mor.*,	Prairie Bluff, &c., Ala.
" arenarum,	Ala.; Miss.
Rudistes Ormondi—*T.*,	Marengo county, Ala.
Scalaria Sillimani—*Mor*,,	Ala.
Scaphites (sp. ?)	Ala.
Serpula triangulata,	Ala.
Terebratula sp.(O.)	Uniontown, Ala.
" sp.(O.)	Uniontown, Ala.

Teredo tibialis,	**Eufaula, &c., Ala.; Miss.**
" calamus,	**Eufaula, &c., Ala.**
Trigonia thoracica,	**Eufaula, Ala.**
" sp. (O.)	**Sumter county, Ala.**
Trochus phorus,	**Montgomery, Greene, and Sumter counties, &c., Ala.**
Turrilites alternatus,	**Ala.**
Turritella fastigiata—*T.*,	**Ala.; Miss.**
" vertebroides—*Mor.*,	Ala.; Miss.
Voluta fusiformis—*T.*,	**Elm Bluff, Ala.; Miss.**
" jugosa—*T.*,	**Ala.**
" cancellata—*T.*,	**Ala.**
" Spillmani—*T.*,	Columbus, Miss.

FISH.

Corax falcatus—*Agass.*,	**Ala.**
Galeus pristodontus—*Agass.*	**Ala.**
Lamna elegans—*Agass.*	**Ala.**
Ptychodus Mortoni—*Agass.*	**Ala.**
" (sp. ?)	Greene county, **Ala.**

B.

CRETACEOUS FOSSILS FROM BELOW AND AT EUFAULA, BARBOUR COUNTY.

Anomia argentea.
" tellinoides.
" (sp. ?)
" (sp. ?)—large.

Avicula lævis.

Cardium (sp. ?)

Exogyra costata.
" (sp. ?)

Fusus Eufaulensis.

Gryphæa mutabilis.

Hamulus (Dentalium) onyx.

Megalodon (Venilla) Conradi.

Ostrea mutabilis.
" falcata.
" larvata.
" crenulata.

Ostrea sub-spatulata.
" cretacea.
" plumosa.

Pecten quinque-costatus.

Pectunculus hamula.

Placuna scabra.

Teredo tibialis.
" calamus.

Trigonia thoracica.

Turritella vertebroides.

C.

GENERAL LIST OF TERTIARY (EOCENE) FOSSILS.

Actæon pomilius.

Ancillaria subglobosa—*Con.*
  " staminea—*Con.*
  " scampa—*Con.*

Astarte recurva—*Lea.*
  " tellinoides—*Con.*

Avicula Claibornensis—*Lea.*

Bulla St. Hilairii—*Lea.*

Cancellaria gemmata—*Con.*
  " sp. (O.)

Cardita plani-costa—*Con.*
  " alti-costa—*Con.*
  " rotunda—*Con.*
  " densata—*Con.*

Cardium Vicksburgense—*Con.*
  " diversum—*Con.*
  " Nicoleti—*Con.*

Cassis Taitei—*Con.*
  " (sp. ?)

Conus sauridens—*Con.*

Corbis lamellosa.

Corbula oniscus—*Con.* (Alabamensis—*Lea.*)
" nassuta—*Con.* (Murchisoni—*Lea.*)
" (sp. ?)
" compressa—*Lea.*

Crassatella Mississippiensis—*Con.*
" alta—*Con.*
" protexta—*Con.*

Crepidula lirata—*Con.*

Cytherea per-ovata—*Con.*
" Poulsoni—*Con.*
" Nuttalli—*Con.*
" (sp. ?)
" globosa—*Lea.*
" Sayana—*Con.*
" albarea—*Say.*
" æquorea.
" eversa—*Con.*

Dentalium bi-formis—*T.*
" thalloides—*Con.*

Egeria rotunda—*Lea.*

Emarginula arata.

Fusus spiniger—*Con.*
" salebrosus—*Con.*
" magno-costatus—*Lea.*
" papillatus—*Con.*

Infundibulum trochiforme—*Con.*

Lucina carinifera—*Con.*
" compressa ?—*Lea.*
" pandata—*Con.*
" (sp. ?)

Lunulites Bouei.

Mactra pygmæa—*Lea.*

Marginella larvata—*Con.*
" ovata—*Lea.*

Melongena alveata—*Con.*

Mitra polaris (?)—*Con.*
" (sp. ?)

Modiola Ducateli—*Con.*

Monoceros vetustus—*Con.*
" armigerus—*Con.*

Natica semi-lunata—*Lea.*
" striata—*Lea.*
" gibbosa—*Lea.*
" magno-umbilicata—*Lea.*

Nucula magnifica—*Con.*
" pectuncularis—*Lea.*
" Brogniarti—*Lea.*

Oliva Alabamensis—*Con.*

Orbitolites discoidea—*Lea.*

Ostrea emarginata—*T.*
" compressi-rostra.

Pectunculus stamineus—*Con.*
" (sp. ?)
" (sp. ?)
" deltoideus—*Lea.*
" Broderipi—*Lea.*
" lentiformis—*Lea.*

Pholas Roperiana—*Con.*

Pleurotoma acuti-rostra—*Con.*

Plicatula Mantelli—*Lea.*

Pyrula elegantissima—*Lea.*
" cancellata—*Lea.*

Rostellaria velata—*Con.*
" laqueata—*Con.*
" alveata—*Con.*

Sigaretus, (sp. ?).

Solarium elaboratum—*Con.*
" alveatum—*Con.*
" (sp. ?)

Turbinella pyruloides—*Con.*

Turbinolia Goldfussi—*Lea.*
" caulifera—*Con.*
" Maclurei.
" Stokesi—*Lea.*
" pharetra—*Lea.*
" nana—*Lea.*

Turritella Mortoni—*Con.*
" (sp. ?)
" obruta—*Con.*

Venericardia parva—*Lea.*
" Sillimani—*Lea.*
" transversa—*Lea.*

Voluta petrosa.
" Sayana—*Con.*
" Tuomeyi—*Con.*
" (sp. ?)
" Defrancii—*Lea.*

FISH.

Carcharias heterodon.
" productus.
" (polygurus ?)
" angustidens.
" auriculatus.

Galeus aduncus.
" latidens.

Lamna duplex—*Agass.*
" verticalis—*Agass.*
" raphiodon.
" cuspidata.
" contortidens—*Agass.*

Otodus (sp. ?)

Oxyrhina hastata.
" xiphodon.

D.

EOCENE FOSSILS FROM NANAFALIA BLUFF, TOMBIGBEE RIVER.

Actæon pomilius—*Con.*

Cardita plani-costa.
" " (var.)

Cardium Vicksburgense—*Con.*
" (sp. ?— same as large one from Claiborne.)

Crassatella Mississippiensis.

Cytherea Nuttalli.
" (n. sp.)

Dentalium bi-formis.

Fusus spiniger.
" (n. sp.)

Monoceros vetustus—*Con.*
" (n. sp.)

Natica (sp. ?).

Ostrea emarginata—*T.*

Rostellaria velata.

Solarium (n. sp.).
" (n. sp.).

Turbinolia caulifera.

Turritella Mortoni.
" (n. sp. ?)

Voluta Tuomeyi—*Con.*

E.

EOCENE FOSSILS FROM BELL'S LANDING, ALABAMA RIVER.

Ancillaria sub-globosa.

Arca (n. sp.—same as Va.).

Cardita rotunda.
" plani-costa.
" (n. sp.)
" decusata.

Cardium diversum.
" Nicoleti.

Crassatella Mississippiensis—*Con.*
" protexta.
" alta.

Cytherea eversa.
" Nuttalli.

Natica gibbosa.
" semi-lunata.
" magno-umbilicata.

Ostrea emarginata—*T.*
" compressi-rostra—*Say.* (large.)

Pectunculus (n. sp.).

Pholas Roperiana—*Con.*

Rostellaria velata.

Turritella obruta.
" Mortoni.
" (sp. ?)
" (sp. ?)

Voluta petrosa.
" (sp. ?)

F.

EOCENE FOSSILS FROM ROCK BRANCH, NEAR MONROEVILLE, MONROE COUNTY.

Actæon (sp. ?)

Ancillaria sub-globosa.
" staminea.

Astarte recurva.
" tellinoides.

Avicula Claibornensis.

Bulla St. Hilairii.

Cancellaria gemmata.

Cardita plani-costa.
" alti-costa.
" rotunda.

Conus sauridens.

Corbula oniscus.
" nassuta.
" (sp. ?)

Crassatella alta.
" protexta.

Crepidula lirata.

Cytherea globosa.
" (sp. ?)
" Sayana.

Dentalium thalloides.

Egeria rotunda.

Infundibulum trochiforme.

Lucina compressa?

Lunulites Bouei.

Marginella larvata.

Monoceros vetustus.

Natica semi-lunata.

Nucula magnifica.
" pectuncularis.

Oliva Alabamensis.

Pectunculus stamineus.
" (sp. ?)
" (sp. ?)
" deltoideus.

Pleurotoma acuti-rostra.

Rostellaria velata.
" laqueata.

Sigaretus (sp. ?)

Solarium elaboratum.
" alveatum.

Turbinella pyruloides.

Turbinolia Maclurei.
" Stokesi.
" pharetra.

Turritella obruta.
" (sp. ?)

Voluta Sayana.
" (sp. ?)

It is to be wished that lists of fossils, like the above, could be presented for the silurian and carboniferous rocks—for such, however, no materials are to be found. For a short list of fossil plants from the coal-measures of the Warrior, determined by Mr. Bunbury, see the first Report, p. 93. [J. W. M.]

APPENDIX No. 4.

LIST OF LOCALITIES

AT WHICH

BEDS OF COAL APPEAR,

EXTRACTED FROM THE REPORTS TO THE STATE GEOLOGIST

OF GEORGE POWELL, ESQ.,

SURVEYOR OF BLOUNT CO.

MR. GEORGE POWELL, County Surveyor of Blount, has, under the direction of Prof. TUOMEY, bestowed much time and labor upon the examination of portions of the coal fields of the State, and has from time to time furnished Prof. TUOMEY with notes of his results. The new geological map of the State exhibits important corrections, based upon them. From such of these notes as remain amongst the papers of the Survey, I find that it would hardly be possible to draw up a full account of the geology of the coal-measures—but a list of the numerous localities at which coal itself was noticed may prove practically useful to many persons in different parts of the State. I have therefore drawn up the following list, from the notes of Mr. POWELL, quoting as far as possible his own words. Some few localities are omitted, where the seams of coal were extremely thin, and of no workable value. [J. W. M.]

LOCALITIES

AT WHICH COAL-BEDS APPEAR.

WARRIOR COAL-FIELD.

McGee's—E. half of S. W. fourth of S. 12, T. 20, R. 10 W. This bed is from 9 inches to 1 foot thick; is very extensive, and excellent coal.

S. of the mouth of Binian's creek, and distant from it 150 yards—near Mr. Pruett's (a little N. of last named locality)—coal is found, 30 or 40 feet above the bed of the creek. It is situated in the side of a hill of deep yellow slaty clay.

Two miles S. W. of D. Smith's, on Winter's mill creek, is a bed of excellent coal, about 12 inches thick.

At Mr. John Williams'—S. 12, T. 17, R. 12 W.—coal was found, in a well, 28 inches thick. Mr. Williams says that, half-a-mile W. of his house, the coal is 3 feet thick. Coal is here very abundant—it is found in three Sections.

At Boxe's creek, in S. 10, T. 16, R. 12 W., Mr. Moore says that there is a coal-bed two miles N. E. of his house, from which smiths in Fayetteville haul coal. Mr. Pryor says that there is another bed, half-a-mile S. E. from his mill, but that the nearest coal that he knows of N. of his mill is about 4 miles up New River, near Adley Harris', and on the E. side of the river.

Near Mr. McCollum's, S. 18, T. 14, R. 11 W., a bed of good coal, 1 foot thick, has been found, situated 30 or 35 feet above the bed of Mill creek. Mr. McCollum says that there is another bed of coal, in the bed of New River, three-quarters of a mile S. E. of his house. It has been worked two feet deep, but the bottom has not been reached.

Mr. G. Brown's, S. 27, T. 13, R. 11 W., three-quarters of a mile S. of the fork of New River. The coal at this place is 2 feet thick, but is said to contain a great quantity of sulphur. There are several beds upon Mr. Brown's land.

Mr. Stephen Vaughan's, S. 23, T. 12, R. 12 W. Here is a bed of hard coal, which has been excavated 3 feet deep, but the bottom of the coal has not yet been reached. The bed is nearly level. Coal is hauled from this place, 15 miles N. W., to Pikeville, and 8 miles S. W. to different smiths.

Lemuel Burnet's, on the W. fork of New River. Here extensive beds of coal are found, but, as usual, none of them have been worked to the bottom. The coal-heavers generally raise coal from two or three feet deep; and, as the beds are in the bottoms and sides of creeks, the water hinders them from going deeper. All the coal on this side of the coal-field is very hard. The smiths say it is good coal. Mr. Burnet says that a Mr. Loden has discovered a coal-bed some 10 miles W. of this—said to be of good quality.

On Buttahatchee creek, near where the road to Russellville crosses, a bed of coal, 1 foot thick, was discovered in the bank of the creek.

7 miles S. E. of Mr. Northington's, S. 34, T. 9, R. 15 W., numerous small seams of coal on a fork of Buttahatchee creek.

At New London, S. 22, T. 9, R. 10 W., information was obtained of a coal-bed, 3 or 4 feet thick, on Big Bear creek.

Sipsey Fork of the Warrior.

At old Baltimore (Eastern part of Hancock county), there is a bed in the river, said to be thick. About 50 feet above the river a thin seam of 2 or 3 inches; and another, 3 miles N. W., near the top of the highest hills in that direction, in some places 2 feet thick, and of good quality.

Two miles from the mouth of Rock creek (near last-named locality) is found a very extensive bed of coal, running up the creek several miles; where measured, the bed was 2 feet thick. 100 feet above the bed of the creek, there is another seam, 6 inches thick, of good quality; and S. of the creek, another seam, in the hills, of 8 inches.

In the bed of the Brushy Fork of Sipsey Fork, there is said to be coal of some thickness.

Near the mouth of Robert's creek, emptying into Sipsey Fork, there is a coal-bed, 7 or 8 inches in thickness, 50 feet above the bed of the river.

At old Warrior Town (junction of Sipsey and Mulberry Forks) a bed occurs, a little over 2 feet in thickness, 50 feet above the river—extends several miles up Sipsey Fork, and at least a mile down stream.

Mr. Jas. Hanby (whose mill is 5 or 6 miles up the Mulberry Fork, from its junction with Sipsey Fork) says that he gets his coal 4 miles S. W. of his mill, near the Oakey Hollow road—that the bed is in the top of a hill, and 4 feet thick.

Locust Fork of the Warrior.

At the mouth of Slab creek, coal shews for over a mile up that stream, about 18 inches thick. From the mouth of the creek, down the river, the coal continues 4 or 5 miles, shewing occasionally. It was said by some persons that a bed of 4 feet had been found in this region—none measured by Mr. POWELL would average over 18 inches. Up the river from Slab creek the coal is said to extend half-a-mile.

From the junction of the Locust Fork and Little Warrior, up the latter stream, several thin beds are found—one is about a foot thick, but not good. Some thin seams have also been found on the left of the two forks which unite just above where the Huntsville road crosses the stream.

The basin of the Little Warrior is well supplied with coal, particularly the part lying next to Murphree's Valley, where three beds occur in pretty regular succession one above another, varying from 2 to 4 feet in thickness.

On Five-mile creek, S. 33, T. 16, R. 3 W., coal was found, 50 feet above the bed of the creek. Another bed, in S. 4, T. 17, R. 3 W., is nearly 3 feet thick, and horizontal; it may be seen for 200 yards.

N. E. ¼ of S. 25, T, 16, R. 4 W, another bed of coal, about 1 foot thick, 104 feet above the great bed in the creek.

At Mr. LYNN'S, where the Jasper road crosses Five-mile creek, coal nearly 4 feet thick was found, 150 feet above the bed of the creek. Another seam, of 1 foot, 30 feet above the former.

A bed of coal, 4 feet thick, is said to have been discovered as far North as Lick creek, a fork of Flint creek, in Morgan county.

CAHAWBA COAL-FIELD.

Near Mr. TRUSS', S. 25, T. 16, R. 1 W., the coal-beds are said to be numerous, but not very thick, and the coal not good for smith's use.

Near the top of a hill, S. of the Cahawba river, S. E. of Mr. TRUSS', coal was found, 40 or 50 feet above the bed of the river.

In S. 26, T. 16, R. 1 E., is a coal-bed from which a great quantity of excellent coal has been obtained. It has been proved to be 3 to 4 feet thick.

A quarter of a mile N. of the house of Mr. THOMAS ATKINS (near last-named locality) there occurs a bed, said to lie nearly vertical, and to be 4½ feet thick—apparently good coal. Some beds, within a mile and a half from this place, are said to be 8 feet thick. Coal is abundant on the N. side of the Cahawba valley almost to its N. Eastern extremity.

Near the forks of the Cahawba, S. 23, T. 18, R. 2 W., on a branch called Coal creek, a regular bed of coal is seen, lying nearly horizontal for several hundred yards in the banks of the creek; then 3 or 4 beds appear to join it at right angles. The examination of this locality was unavoidably left incomplete.

At the head of Black creek—a bed, said to be 4 feet in thickness. The N. E. limit of coal here appears to be in S. 16, T. 15, R. 2 E.

COOSA COAL-FIELD.

Broken Arrow creek, on the road leading from Ashville to Robinson's ferry—a bed of coal was found, which had been excavated to the depth of 3 feet, without reaching the bottom. It is

of good quality. Three or four coal-pits are worked in this region within a few miles. A Mr. SIMS has a bed 3 to 6 feet thick; and Mr. WARREN a bed of 4 feet: S. 1, T. 16, R. 3 E.

S. 27, T. 16, R. 3 E., a bed is said to occur, 2 feet thick, and of good quality.

Mr. BARBER, S. 17, T. 15, R. 4 E., has a bed of excellent coal, nearly horizontal, known to be over 3 feet through.

WM. COLEMAN, S. 21, T. 15, R. 4 E., has a bed from which large quantities of coal have been hauled to the Coosa river.

Mr. BOXE'S, on Trout creek, S. 7, T. 15, R. 5 E. The thickness of the beds on this creek is generally 3 feet—coal good—situated only 3 miles from the Coosa river.

ERRATA.

P. 21, l. 2 *from bottom.* *For* hich *read* which.
P. 31, l. 10. *For* pnrely *read* purely.
" " *For* insolluble *read* insoluble.
P. 32, l. 25. *For* detectek *read* detected.
" l. 27. *For* cntirely *read* entirely.
" l. 30. *For* temparature *read* temperature.
P. 36, l. 11. *For comma after* waters *insert semicolon.*
P. 37, l. 20. *For* silicious *read* siliceous.
P. 38, l. 17. *For* enamal *read* enamel.
" l. 19. *For* stria *read* striæ.
P. 39, l. 5. *Insert comma after* numbers.
P. 53, l. 4 *from bottom.* *For* 42.95 *read* 43.95.
" l. 3 " *For* .40 *read* .19.
" l. 2 " *For* .19 *read* .40.
P. 54, l. 9. *Dele comma after* location. *Insert comma after* limesink.
P. 55, l. 14. *For* .33 *read* .31.
P. 58, l. 16. *For* 99.98 *read* 99.86.
P. 64, l. 18. *For* quartzos *read* quartzose.
P. 66, l. 3. *Dele comma after* which.
P. 68, l. 16. *For* Syentusah *read* Syenite.
P. 71, l. 4. *For* pour *read* pan.
P. 74, l. 14. *For* tuxa *read* tufa.
P. 76, l. 5 *from bottom.* *For* to-day *read* to day.
P. 82, l. 17. *For* WILLIAM'S *read* WILLIAMS'.
" l. 24. *Insert comma after* limestone.
" l. 2 *from bottom.* *For* tne *read* the.
P. 94, l. 8 *from bottom.* *For* MURPHY'S *read* MURPHREE'S.
" l. 5 " *For* Greenesboro' *read* Jonesboro'.
" *last line.* *For* Trassville *read* Trussville.
P. 95, l. 12. *For* 19.89 *read* 17.89.
P. 98, ll. 4 & 5. *For* RERSEU *read* RERSEN.
P. 102, l. 17. *For* beds *read* bed.
" l. 9 *from bottom.* *For* lustro *read* lustre.

P. 104, l. 7. *For* Lime *read* lime.
" l. 12. *For* Insolluble *read* Insoluble.
" l. 22. *Dele comma after* soil.
" l. 6 *from bottom. Comma instead of period after* calc-spar.
P. 105, l. 19. *Comma instead of period after* river.
P. 106, l. 7. *Insert* ore, with *after* and.
" l. 8. *Dele* ore.
P. 109, l. 16. *Dele comma after* surface.
P. 111, l. 5. *Insert comma after* facts. *Dele comma after* land.
P. 112, l. 14. *Period instead of comma after* rock.
P. 113, l. 21. *Dele comma after* determined.
" *last line. For* eopper *read* copper.
P. 114, ll. 25 & 26. *For* quarzose *read* quartzose.
" ll. 26, 27, 28, & 29. *For* sulphate *read* sulphuret ?
P. 116, l. 8. *For* SAUTT'S *read* GANTT'S.
P. 117, l. 12. *For* NIY *read* NIX.
" l. 22. *Dele* the *before* compactness.
" l. 26. *Insert* (that of Mr. LIEBER) *after* report.
P. 119, l. 20. *For* 6 x 3 ft., 4 x 2 in., *read* 6 ft. x 3 ft., 4 in. x 2 in.
The M. S. has been followed in the adjoining lines, but there is obviously some error in the numbers given.
" l. 3 *from bottom. For* Silicia *read* Silica.
P. 120, l. 19. *For* Emaukee *read* Emauhee.
P. 122, l. 19. *For* goop *read* good.

p. 125, l. 23. *Dele comma after* about.
P. 126, l. 10. *For* benfits *read* benefits.
P. 233, l. 8 *from bottom. For* bluff *read* bluffs—*omitting the comma.*

It is but justice to the present contractor for the State printing, DR. N. B. CLOUD— *and to his predecessors,* MESSRS. BATES & LUCAS—*to state that, out of the above long and vexatious list of errors allowed to go to press, all, with the exception of the last three (slightly separated on the list from the rest), are found in the portion printed by the latter; while, in the rest of the work—executed by the present contractor—but these three errors have been detected—yet equal care was bestowed upon the correction of proofs furnished by both.* [*J. W. M.*]

On p. 164, l. 3, there is manifestly some error in the mention made of La Grange and Wetumpka, but it exists in the M.S., and it is difficult to suggest a probable correction.

In (Fig. 22), p. 106, the letter *a* at the bottom of the woodcut should have been omitted. In (Fig. 39), p. 246, the letter *c* at the bottom should have been *e*.

GEOLOGICAL MAP

AND

GENERAL SECTION.

A geological map was prepared to accompany the first Report —that of 1849—but it was not received from the printer in time for publication with the Report. It appears to have been the intention of Prof. TUOMEY to add this map to the present Report, but, on examination, I found that the greater number of copies of the map had been from time to time obtained by holders of the volume to which it originally belonged, or had been in other ways scattered over the State, so that nothing like a sufficient supply for the present Report could be had—in fact, it is doubtful whether 200 copies could have been collected. Professor TUOMEY had, however, left a large map of the State, with the principal results of his latest explorations laid down upon it—and, it being desirable that these should appear with the present Report, the geological tints of the map just mentioned were transferred to a map upon a reduced scale, which is placed at the end of this volume. Its clear and uniform coloring is due to the comparatively new process of chromo-lithography. The general section, which accompanies it, is taken from the margin of the map of 1849.

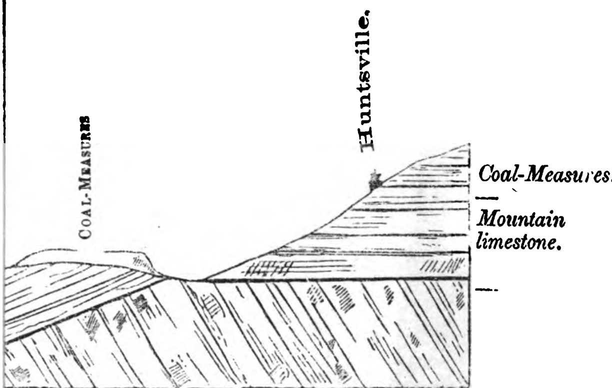
The following portion of Professor TUOMEY's remarks upon the old map will apply to that now published:

"*This map is intended to present at a glance the great geological features of the State, and to direct especial attention to those formations that include the most important of the industrial resources of Alabama. East of the Coosa, that portion of the map colored red, and having its Southern boundary on a line with Wetumpka, includes the primary rocks, and with them the gold-bearing rocks of the State —we have here the Southern extremity of the gold formation of the Atlantic States. The silurian, or oldest fossiliferous, rocks are colored purple; they have their Southern termination at Centreville, on the Cahaba—the principal iron-ore deposits, beds of manganese, marble, and hydraulic limestone occur here. The part of the map colored blue represents the carboniferous limestone, in which the remarkable caves of the Northern part of the State are found. The narrow band of orange indicates the position of the thick beds of sandstone and conglomerate, called the 'mill-stone grit,' that underlie the coal formation. The coal-measures are colored black—the relative extent and position of the coal-fields are indicated with sufficient distinctness. The green belt extending across the State from East to West represents the cretaceous or prairie region—it must not, however, be supposed that the whole of this belt is covered with prairies—on the contrary, beds of sand, pebbles, etc., belonging to a newer formation, overlie no inconsiderable portion of it. These beds have not yet been studied with sufficient care to be fully located on the map—the principal part of the country covered by them, however, is that colored brown, lying immediately North of the cretaceous. From the lower edge of the cretaceous belt to the Gulf, the part of the State colored yellow, is occupied by the tertiary formation—it is here that those valuable deposits of marl occur, similar material to which, judiciously applied upon the lands of Eastern Virginia, has produced such immense benefit.*"

It may be of interest to those persons who possess the map of 1849 to notice the corrections of its geological coloring shewn by the present one—the results of the Survey explorations of the years 1854 and 5.

It will be seen that the boundaries of several of the formations, which have been traced with greater accuracy than before, have been changed upon the map, in some places to the extent of several miles. This is true of the metamorphic rocks, and of the larger belt of post-tertiary sand and gravel stretching across the central part of the State. The silurian rocks are shewn coming to the surface on several of the streams of North Alabama, where formerly they were wanting. The coal-measures of the State are greatly changed, extended on the North-west, and for the first time shewn to form three distinct coal-fields—those of the Black Warrior, the Cahaba, and the Coosa. The Northern limit of the cretaceous formation on the East is found considerably lower down the Chattahoochee than before; and the Northern boundary of the tertiary, from the Alabama river to the Georgia line, is extended further North by some 10 or 15 miles.

J. W. M.]



Silurian and Devonian.

n of the Strata.